ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XXIII. No. 4.

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ENGINEERING NEWS.

THE FASSETT RAPID TRANSIT BILL, now before the New York Legislature, names seven commisioners to transact the business contemplated. These commissioners are MAYOR GRANT, CHAS. S. FAIRCHILD, JOSEPH J. O'DONOHUE, CHAS. J. CANDA, WM. L. STRONG, FREDERICK T. BROWN and GEORGE H. ROBINSON. This Commission is to select routes and decide upon plans, and then submit both to the New York Board of Aldermen, who must submit them within ten days to the Common Council, with any modifications and conclusions, and the Common Councils must return them so that all the business can be finished within thirty days. After the consent of the local authorities is obtained, the Commission is to apply to the property holders, and they have the power to take, in lieu of consent, the condemnation of three commissioners appointed by the Supreme Court. The Commission is then to advertise for sale the privileges or franchises of these roads and the right to build the same. The commissioners may employ engineers and lawyers to assist in the plans and to see that the roads are properly constructed. The Act does not interfere with existing corporations, and streets now occupied by elevated roads are excepted, as are also Broadway below 33d St., Fifth Avenue, Fourth Avenue above 42d St., and Madison Avenue.

THE HENNING TUNNEL BETWEEN BROOKLYN AND NEW YORK is again under discussion. As before described, this is a scheme whereby cars are to run down a steep incline on one side of the river and then up on the other by the force thus stored. The gradient now spoken of is 1 ft. in 4 ft., or a 25 per cent. grade. This is unnecessary and absurd, though it is mentioned that it can be reduced by lengthening out the approach. No soundings have yet been taken in the river bottom to discover whether tunneling is possible or not. The scheme is still very incomplete and we have authority to emphatically deny the report in *The Sun*, that the chief engineer of the Pennsylvania Railroad has approved of the project.

AN EAST RIVER TUNNEL CO. has filed articles of incorporation in Albany. The tunnel is to be located between Broadway, in Brooklyn, and Grand St. in New York. It is proposed to tunnel through rock and it is claimed that borings have been made over the line to rock. The estimated cost is $4,000,000. The names of the incorporators are not mentioned

THE JERSEY CITY ELEVATED RAILWAY, which is to run from Communipaw to Jersey City Heights, will probably be pushed rapidly along so that a part of the line may be in operation by the end of the year. The road will be operated by cable and will have maximum grades of 3 per cent. Cars will be run at a speed of 12 miles per hour and it is expected that in the busy hours three or four car trains at five minutes headway will be required to carry the traffic. The total ascent of the road will be about 40 ft. The rails will be laid on longitudinal beams resting on the girders, and no cross ties will be used. For nearly a mile from the ferry the road will run through the yards of the Central Railroad of New Jersey, and pile foundations will have to be put in to support the columns. Press reports state that some of the piles will have to be driven 87 ft. to reach hard bottom. Mr. A. C. CHENEY, of the Garfield National Bank, is President of the Company and E. C. HARRISON is Chief Engineer.

A BRIDGE ACROSS THE HARLEM RIVER, at Seventh Avenue, New York, is now before the Legislature in the form of a bill appropriating $600,000 for this purpose. The Park Commissioners are inclined to shift the responsibity for its execution onto the Department of Public Works, along with the 155th St. viaduct which is to connect with it, but Commissioner GILROY does not want it, and the matter is being further argued.

THE BALTIMORE BELT RAILROAD COMPANY, organized about a year ago to build a freight transfer and rapid-transit railway around the city of Baltimore, is now before the City Council with an ordinance granting a franchise for the construction of the proposed road. The tracks are to be partly underground and all railways entering the city will have a right to their use on equal terms. Two large union passenger stations and ample sidings for the accommodation of the manufacturers along the line are among the features of the scheme. Among those at the head of the enterprise are WM. GILMOR, President of the Maryland Central Railroad, W. F. FRICK, and JOHN B. MCDONALD of the railway contracting firm of Ryan & McDonald.

A BALTIMORE ELEVATED RAILWAY is projected by the Western Maryland Railway Company to give its lines a terminus near the business centre of the city. The road would carry a heavy city and suburban passenger traffic besides its through business. Preliminary surveys, to determine the feasibility of such a road, have already been made with favorable results.

THE CHICAGO & SOUTH SIDE RAPID TRANSIT CO. has let the contract to the Keystone Bridge Co. for building three and one half miles of the Alley Elevated Railway from State Street to Wabash Avenue, the first mile to be completed by March 26. The road will be carried by two rows of columns set 12 ft. apart transversely, and 50 ft. longitudinally, and on these will be set plate girders well braced transversely. The tracks will be laid with 75 lb. steel rails. A majority of the stock of the company has been secured by the Chicago City Railway Company.

THE MOST SERIOUS RAILWAY ACCIDENT OF THE WEEK, in every sense, was a rear collision which happened on the evening of Jan. 18, on the Cincinnati, Hamilton & Dayton Railroad, about six miles out of Cincinnati. We rehearse the circumstances in another column: five persons were killed (two or three burned alive) and two injured, as the net effect of careless block-signaling, car stoves, and ready telescoping from lack of some device to hold the car platforms firmly in line with each other.—A car of the United States Express Co. caught fire Jan. 17, near Hopewell, N. J., while attached to a Philadelphia & Reading train. The car was uncoupled, and was very soon burned to the ground. It is supposed to have caught fire from the stove.

BRIDGE ACCIDENTS are reported as follows: Jan. 20, a highway bridge in the course of construction over the Little Miami River, in Warren County, northeast of Cincinnati, O., where the little Miami Railroad touches the river at Oregonia station, fell with the workmen on the river span, throwing them into the river, 25 ft. below. The span was of iron 230 ft. long—On Jan. 14, a trestle at Palmyra Tenn., on the Memphis branch of the Louisville & Nashville Railroad, gave way under a freight train.

THE LATEST CAISSON NEWS FROM LOUISVILLE, as gathered at the inquest of Jan. 19, would seem to indicate that there had been a fight in the caisson between the black and the white laborers preceding the accident. The lower lock-tender, BALDWIN, admitted that if he had been at his post he could have saved the lives of the men. He says that he was sent outside on an errand by KNOCH, the foreman. The four colored men who escaped have disappeared from Louisville, and could not be produced at the inquest.

FOR THE THIRD TIME in its brief history, there was last week quite a serious fire in the Tribune Building, in which the office of this journal is situated; but although the fire had obtained considerable headway, enough to cause a loss of nearly $3,000, no serious harm resulted, nor even general alarm. Except for the fire proof construction of the building each one of these fires would probably have caused its loss. The Western Union Telegraph Building has also been on fire several times without serious results.

THE PIKE'S PEAK RACK RAILWAY, running from Manitou, Col., to the summit of Pike's Peak, a distance of about ten miles, is, according to press reports, to be lighted by electricity the entire length. The light will be supplied by arc lamps placed at intervals along the track. The electricity will be furnished by a plant situated at the foot of the incline

THE BROOKLYN, N. Y., SUBWAYS now contain 3,007 miles of wire according to the last report of President GEORGE W. PLYMPTON of the Commission of Electrical Subways. About 768 miles of conductors have been strung under the elevated railways in addition to the above. In the last eleven months 839 miles of wire have been put underground. Mr. PLYMPTON advocates separate conduits for high-tension or electric light and power wires; he deems the present conduits unsafe for this purpose and asks from the Legislature a release from the absurd conditions of the Act of June, 1885, compelling the electric light companies to use a conduit which the Board has neither the authority nor the means to construct. The wire mileage of the electric light companies in Brooklyn is 341 miles, and this is as yet practically undisturbed.

WATER WASTE PREVENTION is being attempted in Buffalo, N. Y., by the issue of the following notice to consumers:

INSPECTOR'S LEAK AND WASTE NOTICE.

TO OWNERS OR TENANTS OF No. ..... St. } Buffalo 189

You are hereby notified that the leaks at ..... on your premises must be repaired within five days from date. If not repaired, the water will be turned off until repairs are made and all expense in turning off paid.

By order of Water Commissioners,

.....
Inspector.

The Water Commissioners, in using this notice, say that 70 per cent. of the daily pumpage is wasted, and they have determined upon a house-to-house examination of fixtures after Jan. 13. The pumpage last year was equivalent to over 250 galls. per head of present population per day, the largest consumption of any city in the United States.

THE NEW CROTON AQUEDUCT COMMISSION has by formal resolutions offered to employ its engineering staff to make the surveys and maps for dam site "D." This is done to meet the objections of Commissioner of Public Works GILROY that his engineers are busy on the survey for reservoir "M," and cannot now get at "D." The Commission say that Mr. GILROY is working on the floor line and upper portions of "M," work which will not be needed for two years to come.

THE NEW YORK HIGHWAY COMMISSION BILL was introduced into the Legislature on Jan. 21. This

bill authorizes the Governor to appoint a commission of three citizens, "two of whom are to be practical and experienced civil engineers," with salaries of $3,000 each and $500 travelling expenses. This commission is to prepare maps, plans, and specifications for the construction and maintenance of a system of State highways in each county, excepting Kings and New York. Two-fifths of the cost of these improvements is to be paid by the property owners benefitted and three-fifths by the counties in which the improvements are made. The County Boards of Supervisors in the 58 counties of the State are to meet and select the highway best suited for improvement "by use, location and commercial importance." The Commission, after their plans are completed, will invite sealed proposals for construction. A period of twenty years is proposed in which to bring about the completion of the work contemplated. The sum of $25,000 is also appropriated to defray the expenses of the Commission.

THE GEOLOGICAL SURVEY OF NEW JERSEY now offer sets of their twenty exceptionally fine maps well bound in atlas form, with maps mounted on muslin and guarded, for $13.50 each. As before announced they also sell single maps at the uniform price of 25 cents each, either singly or in lots. This amount is the bare cost of paper, printing, and postage. Address Mr. WM. M. FORCE, Secretary, New Brunswick, N. J.

PARIS EXPOSITION STATISTICS, as gathered by the police, subdivide the visitors to the Exposition as follows:

5,000,000 provincials and 1,500,000 foreigners visited the Exhibition. The foreigners included 380,000 English, 225,000 Belgians, 160,000 Germans, 56,000 Spaniards, 52,000 Swiss, 38,000 Italians, 32,000 Austrians, 7,000 Russians, 5,000 Greeks, Turks, and Roumanians, 3,500 Portuguese, 2,500 Scandinavians, 8,000 Asiatics, 12,000 Algerians and other Africans, 90,000 North Americans, and 25,000 South Americans.

ACCORDING TO THE *Schweizerisch Bauzeitung*, the great manufacturing companies, Esche Wyss & Co. of Zurich, the Oerlikon Machine Works, and Zschokke & Co., Aarau, will build a dam across the Rhine at Rheinfelden, above the famous rapids, and utilize the power so gained to generate electricity, which will be carried to Basel, Liestal, Arlenheim, Sackingen, and Wiesenthal by large copper wires. A meeting of the parties likely to be injured by this dam has been held and has decided that the project is practicable, and without danger to any existing interests.

We regret that "Examinations: Their Uses and Abuses" is not a live enough subject to warrant us in republishing or fully abstracting a lecture under that title by Prof. KERNOT, delivered in June last at Queen's College, University of Melbourne. It is a most sensible paper and those having reason to be interested in the subject of examinations, either for the civil service or in colleges, will do well to write to the author for a copy of the paper, which will be gladly furnished.

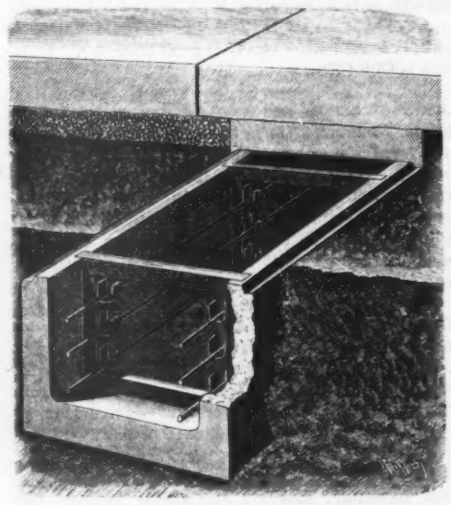
A TEN-INCH GAUGE.—A wonderful railroad is the one which connects the towns of Bedford and Bellevue, Mass. It is 9 miles in length, and is probably as unique as any on the globe. The distance is not so astonishing, except when the gauge of 10 ins. is considered. In the short distance traversed by the pigmy it crosses eleven streams, with bridges from 5 to 35 ft. in height. The rails weigh but 20 lbs. to the yard, about the size of those used in the mines of Missouri and Illinois. The cars and engines are constructed so as to be very near the ground, insuring greater safety. The cars are provided with single seats on each side of the aisle. The car itself weighs but 4 tons, the weight of an ordinary car being 20 to 26 tons. The engine, without the tender, weighs 7 tons, and runs with two passenger or freight cars at the rate of 20 miles an hour. There is a smaller railroad than this in the United States—the one in Bucks County, Penn., but it is only kept as an expensive toy by a rich farmer who has made a fortune out of oil.—*Albany Argus.*

Electric Subways and Cables in Paris.

Paris has lately introduced an electric lighting system for use in the various great markets of that city. The installation includes the Edison and Ferranti dynamos and the Edison distribution, and is fully described in *Le Génie Civil* of Nov. 30.

An interesting feature is the subway adopted and here illustrated. It is placed under the pavements, as it was believed that the sewers were too damp for the successful working of the system. This dampness was likely to produce disturbing induction between the electric light and telephone cables, and they would be further exposed to careless or malicious handling by the many workmen circulating through these sewers.

As shown, the cables are placed immediately under the paving slabs in moulded cement channels, about 10 x 12 ins. inside measurement, and covered with cement blocks. About every 5 ft. wooden



Paris Subway for Electric Light Wires.

frames hold cast glass hooks which support the cables. Under the streets, where the soil is more damp and permeable, and where the charge is heavier, the cables are placed about 3½ ft. below the surface. At each angle of a street intersection a connecting well establishes communication between the street and pavement subway.

The cables are made of wires of galvanized copper of a number and diameter varying with the location. These wires are twisted together and covered with a coating of pure rubber: around this again is two millimetres in thickness of a rubber compound, and about the whole are wrapped two ribbons of cotton dipped in rubber. This whole cable is vulcanized into a compact mass, and finally covered with a strong twist of hemp dipped in rosin, tar, or bitumen.

The section of the exterior system of cables is given as follows:

Feeders.	*Extreme wires.*	*Neuter wires.*
1	80 mm. sq.	40 mm. sq.
2	120 "	80 "
3	80 "	40 "
4	100 "	80 "
5	120 "	60 "
Distribution Circuit Uniform section	40 mm.	20 mm.

These cables have been calculated for a mean density of 2 amperes per sq. mm., and for a fall of potential of 10 volts. The resistance of insulation is figured at 300 megohms per kilometre, at 24° Cent.

In certain parts of the city it was necessary to put the cables in the sewers; and to prevent disturbance of other currents, recourse was had to concentric cables, made as follows:

A core of 19 copper wires of 2 mm. made a section of 60 sq. mm. These were galvanized and twisted and covered—(1). With two coats of pure rubber 1 mm. thick in all; (2) by several coats of vulcanized rubber 8 mm. thick in total; (3) by two ribbons soaked in rubber and rolled in opposite directions. A series of copper wires rolled in a spiral about the first formed a second circuit, having the same section, and this compound cable was then covered—(1) with two coats of pure rubber; (2) with several coats of vulcanized rubber 3 mm. in total thickness; (3) with two rubber-dipped ribbons rolled in the opposite direction; (4) with a covering of hemp dipped in a resinous composition, 3 mm. thick; (5) two ribbons of woven cotton coated. This whole cable was finally enclosed in a leaden pipe 2.5 mm. thick, covered with a strong net of fibre dipped in a bituminous compound.

These cables are supported on wooden rests built into the sewer masonry. The resistance of insulation is figured at 1,500 to 3,000 megohms per kilometre of cable.

Compound Locomotive, Michigan Central Railroad.

A compound locomotive, built by the Schenectady Locomotive Works, of Schenectady, N. Y., has recently been put in service on the Michigan Central Railroad. The engine is of the ten-wheel type adopted by this road for fast passenger service. The compounding is on the Von Borries and Worsdell system, with two cylinders. Some improvements in detail, including an arrangement by which the number of handles to be used by the engine driver is the same as on a simple engine, have been introduced by Mr. PITKIN, Superintendent of the Schenectady Locomotive Works, who has patented his designs. Live steam may be admitted through a reducing valve to the low-pressure cylinder in starting; this valve is set at 90 lbs. The steam valves are of the Allen-Richardson type, operated by the regular link motion. A combined safety and relief valve is fitted to each steam chest, and to each head of the low pressure cylinder; these latter valves are set at about 110 lbs. The boiler is of the wagon-top type and the boiler pressure is 180 lbs. The fuel is soft coal.

The following are the principal dimensions, etc.: Cylinders: High pressure, 20 x 24 ins., low pressure 29 x 24 ins. Travel of valves, 6⅛ ins.; diameter of driving wheels, 68 ins.; diameter of truck wheels, 30 ins.; rigid wheel-base, 6 ft. 3 ins.; driving wheel base, 12 ft. 3 ins.; total wheel base of engine, 22 ft. 6 ins.; total wheel base of engine and tender, 48 ft.; total length of engine and tender, 59 ft. 2 ins.; weight on driving wheels, 97,000 lbs; weight on truck, 29,800 lbs.; total weight of engine, loaded, 126,800 lbs.; total weight of tender, loaded, 81,000 lbs.; diameter of boiler, 58 ins.; size of fire box, 96 x 42 ins. Tubes, No. 247: length, 12 ft.; diameter, 2 ins. Heating surface, nearly 1,700 sq. ft.; grate area, 28 sq. ft.; tank capacity, water, 3,700 galls.; tank capacity, coal, 8½ tons.

A trial run was made on Jan. 9, and the following notes are taken from an article in the Detroit *Free Press* of Jan. 10.

The new compound locomotive known as No. 284, hauled the day-express train west on the Michigan Central Railroad to day as far as Michigan City (228 miles). This run of passenger trains is always made by two locomotives, the first going from Detroit to Jackson, (76 miles) and the second from Jackson to Michigan City (152 miles.) No. 284 might just as well have hauled the train to Chicago, over the third division, being quite capable of doing the work and having in the tender a sufficiency of coal, originally taken on at Detroit, to have completed the full run of 285 miles between Detroit and Chicago.

The train on leaving Detroit consisted of nine cars, being one car more than its usual number. The weight of the train, including engine and tender, is figured at 705,000 lbs., or 359 tons. The tender was loaded with less than nine tons of coal, of which amount something over seven tons were used on this run. Ordinarily, the standard engines use about seven tons of coal between Jackson and Michigan City with such a train as No. 284 pulled through to-day. The railroad people are consequently pleased with the results achieved in the way of economizing fuel, as demonstrated on this run.

The new engine made steam very freely. The pressure, steadily maintained on the steam gauge, was 170 lbs., never below that, but sometimes above it. The train, leaving Detroit at 9 A. M., arrived at Michigan City at 4.36 P. M., being 7 hrs. 36 mins. making the run of 228 miles. The rate, including stops, is 30 miles an hour. Ninety minutes were taken up in detentions at stations, which includes all the incidental work of handling baggage, meeting trains, and the regular work at stations. The last run of the engine, 36½ miles, between Niles and Michigan City, was made in 57 mins. The schedule time for this part of the run is 62 mins.

Buffalo Steel Pressure Blowers.

The annexed engraving illustrates a Buffalo Steel Pressure Blower on a recently perfected pattern of adjustable bed with countershaft, designed and constructed with special reference to high-pressure duty, such as supplying blast for cupola furnaces, forge fires, and sand-blast machines, also for forcing air long distances.

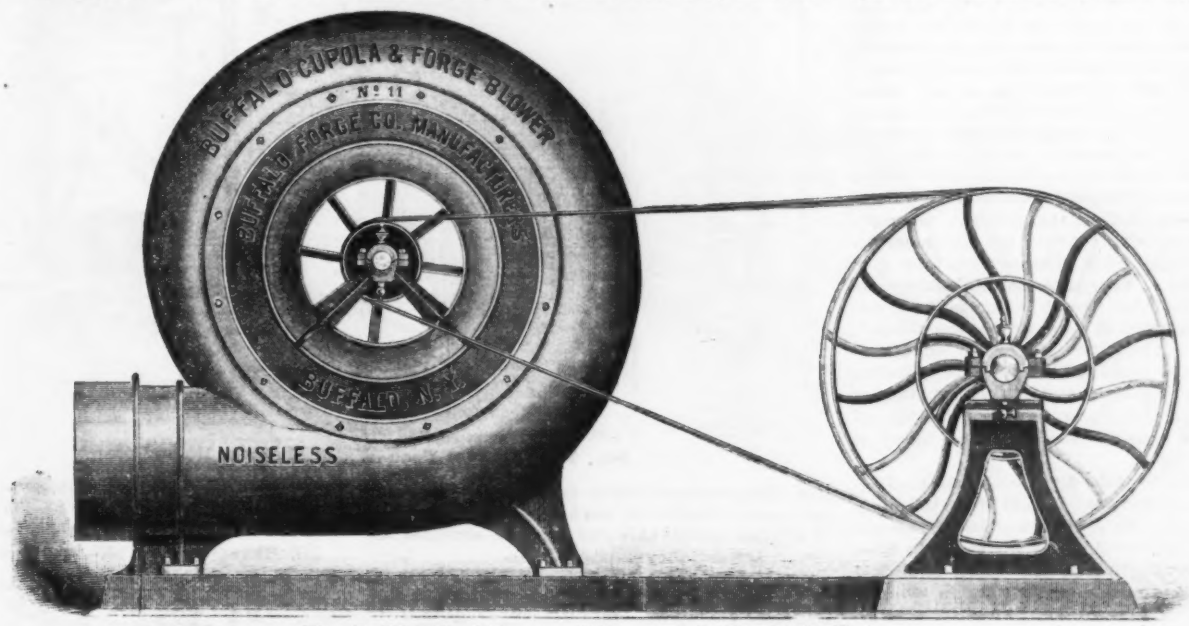
By means of a tightening screw, the blower may be moved upon the bed while running at full speed taking up any slack, giving both belts a uniform tension, which is regulated at the will of the operator, and is a very important point in preventing the inconvenience and loss incurred by a stoppage during heat when blowers are used for cupola purposes. A decided saving by use of the bed is gained in the wear and tear of belts, for a simple turn or two of the nut on end of adjusting screw and retightening of the holding down bolts takes but a moment or two and accomplishes the same end as relacing of the belts, which usually is put off until the belt will run no longer on account of so much slack.

Special attention should be directed to pressure blower belts on account of the high rate of speed at which they must necessarily run, and absolutely perfect alignment of the countershaft with the blower is essential in order to secure smooth running and even tracking and to avoid undue wear of belts by slipping.

A telescopic mouth-piece is employed in order that the blast piping may not be disarranged in moving the blower on the bed, while sufficient length is afforded to the countershaft so that tight and loose pulleys can be used for the main driving belt. A self-oiling device fitted to the countershaft enables it to be run at high speeds for long stretches with perfect immunity from heating or cutting.

A distinguishing feature of these blowers is the solid case, the peripheral portion of the shell being cast in one solid piece, to which the center plates are accurately fitted, metal to metal, dispensing entirely with the objectionable "putty joint." Thus being practically one piece, under the hardest service the bearings must always be in perfect alignment vertically and laterally with the rest of the machine, thus making it superior in items of durability, smooth running, and economy of power to any other journal bearing in use.

The journals are long and heavy, in the standard ratio of length to diameter of 6 to 1, with cap bearings secured by bolts screwed in lower half of bearing, held in place by lock nuts. It is impossible for bearing to rattle loose, and any wear can be at once taken up. It is made by the Buffalo Forge Co., Buffalo, N. Y.



The Buffalo Steel Pressure Blower with Adjustable Bed.

Preparation of Asphalte Comprime.

From a memoir published by the "Compagnie Générale des Asphaltes de France" the following matter is translated relating to the preparation of *asphalte comprimé:*

The operations preliminary to the application of asphalt to the street surface are the extraction and crushing of the rock, the heating of the powder and its transport to the point of application while still warm.

The best material for the mastic used by this company comes from the Pyrimont mines of the Seysse region, in the Department of Haute Savoie and Litin, France. The workings are in a great part subterranean and the deposit lies in eight superimposed beds separated by beds of white limestone; one of these asphalt beds lies about 100 ft. above the level of the Rhone and has a thickness of 23 ft.; it is the largest of all known beds of this material. The galleries now driven aggregate about seven miles in length.

The rock is extracted in a temperature ranging from 53° to 55° Fahr., and it is relatively hard; this desirable quality can be increased by taking it outside during the winter; but it should not even then be exposed to the sun. Dynamite or gunpowder is used in extracting it, the latter being used when the mass is compact, dry, and without fissures. As the rock is to a certain degree plastic, it compresses easily, and does not work well with the more violent and quick explosives. On the other hand, dynamite is effectively used in the wetter parts of the mine, and in places where fissures would permit the slower-acting gases from gunpowder to escape without efficient work.

The asphalt blocks are removed outside by rail, and as few as possible are piled upon one car to avoid crushing under the effect of the heat of the sun. This crushing is undesirable for two reasons; first, there is more waste in transport and handling, and secondly, if rain falls upon a pulverized mass, it absorbs water rapidly and becomes exceedingly difficult to treat.

The rock is submitted to different operations after extraction, according to its later use as asphaltic mastic or *asphalte comprimé.* Bitumen and asphalt powder mixed make the mastic commonly called *asphalte coulé*, and used for sidewalks, etc. The asphalt powder is obtained by pulverizing and seiving the rock. It is first crushed to about the size of macadam paving, and then taken to the rolls for finer reduction.

When used for *asphalte comprimé*, the powder is heated in a rotary apparatus of which the following is a description: Imagine a huge "coffee-roaster," of which the cylinder is about 6½ ft. in diameter and the same in length; its double envelope carries a chimney of sheet iron, disposed in such fashion that the heated air from the furnaces passes all around the cylinder. The furnace itself is movable and placed immediately below the cylinder, and rests on a railway so that it may be run out of the way. The moving cylinder is mounted upon an axle supported on journals in the enveloping cylinder, which latter rests on four stout legs.

The powder is put into the "roaster" by means of a hopper placed opposite a central hole forming an annular space around the axle. The powder falls into the cylinder, which is moving very slowly and is provided with interior blades arranged in a spiral; the contents are lifted up to the top, and fall in a shower through the hot air in the cylinder until it is thoroughly warmed both by this action and by contact with the hot sides of the cylinder. As the movement of the cylinder is perfectly regular, the powder remains on the blades only a determinable time, and the entire mass has imparted to it a uniform temperature. The apparatus used on the works of the city of Paris heat, to a temperature of about 300° Fahr., about 3,960 lbs. of powder in fifteen minutes.

When the powder is sufficiently heated, the furnace is run out from under it, and is replaced by the special wagon used for transporting the warm powder to the point of use, into which the powder falls after opening a gate in the side of the cylinder. Asphalt is a bad conductor of heat, and this negative quality much simplifies the difficulties of its preparation, and permits it to be heated at central stations and conveyed a considerable distance before it will appreciably fall in temperature. In fact, the powder, loaded into metallic wagons provided with a tight cover, may be carried from 1½ to 9½ miles from the point of heating to the point of use on the streets, without losing on the way more than 35° to 40° Fahr. of its mean temperature. The spreading, ramming, ironing, etc., of the asphalt to complete a pavement have been so often described that we will not repeat the description here.

THE WOONSOCKET, S. DAKOTA, ARTESIAN WELL is now 725 ft. deep and throws 6,000 galls. of water per minute, or 8,640,000 galls. per day, says an exchange. The water is clear and soft. The pressure is 167 lbs per square inch. The well is 6 ins. in diameter and an attempt to get it under control is proving difficult. It might also be said that the flow of the well seems as yet to be "estimated" only, and the several press accounts naturally vary as to the quantity.

A RUMOR is going the rounds to the effect that all the switchmen on the Tabor & Northwestern Railroad have struck. The line of road mentioned was opened a few weeks ago and is 10 miles long. It is possible that it employs one switchman, but the head brakeman, if he is a rustler, ought to do the work. No interruption in through traffic is likely to ensue if the whole force of the road, from superintendent down, should strike.—*Omaha Republican.*

Performance of the Best Modern Pumping Engines, compared to that of the Cornish Pumping Engines in the Period of 1840.

By Prof. J. E. Denton, Stevens Inst. of Technology.

(*Continued from Page 53.*)

ABSTRACT OF RESULTS OF TEST OF PERFORMANCE OF PAWTUCKET PUMPING ENGINE*.

General Description of Pumping Plant.—This is shown in Fig. 17.** Each steam piston acts directly upon a submerged plunger, under control of the vibrating levers and crank on the fly-wheel shaft. By connecting the latter from a point on the levers having twice the radius of the point receiving the surplus piston thrust, the effect of the latter upon the fly-wheel shaft is divided by two. The valves of each of the pumps are 280 in number, consisting of a disc of sheet copper about 2 ins. diameter, which provides sufficient area to require a very small lift. As indicated in the figure, the boilers are within 10 ft. of the steam chest the steam supply pipe being indicated with the thermometer *M* inserted therein. The water pumped is drawn from a well under about 13½ ft. lift and delivered through a main averaging 20 ins. in diameter, which leads from the pump through the principal streets of the city of Pawtucket and thence into a reservoir about 4 miles distant. The head pumped against averages 270 ft. Water is drawn off from the main pipe to supply the needs of the city between the pump and the reservoir through branch pipes ranging from 6 to 12 ins. diameter. The engine makes about 49 revolutions per minute, the speed being controlled by the action of a governor in combination with the well known Corliss valve gear, the cut-off being variable on both the high and low pressure cylinders. The feed water for the boilers is taken from the hot well and delivered by a pump worked from the vibrating levers as is also the air pump which is shown at *N*, Fig. 17.

The condenser is of the jet type and the condensing water is supplied automatically from the pump well through the pipe *J*. Steam of boiler pressure is maintained in jackets which surround the sides and heads of both cylinders. The steam condensed in these jackets is withdrawn by a pump situated below the cylinders and worked by positive connection with the engine. This pump delivers the condensed jacket steam into the feed pipe *D G* at a point nearly below *M*. A similar pump circulates the condensed steam from the receiver through a heater in the flue and thence back to the receiver. Under these arrangements the sole use for steam about the pumping station during warm weather, when the tests were made, is to supply the engine. As it was believed that the high economy with which the plant was operated was due in some measure to the fireman being trained to restrict the coal burned per hour to a certain amount which long practice had shown to be the average consumption of the engine, it was considered desirable to avoid any arrangement for testing such as an auxiliary feed pump, etc., which, would alter the usual steam consumption of the plant or the temperature of feed water. This was accomplished by the use of a meter at *A* to measure the feed water. The latter was checked by the measurement of the water discharged to waste from the hot well by means of exhaust meters. Figs. 17 and 19. The tests were made about June 1. In March the engine had undergone its usual two days of overhauling. It was tested in the condition found at the time of the writer's arrival, without any extra preparations. The anthracite coal used was a part of that which had been purchased for the season, so that the engine was tested under the conditions common to its regular daily work.

PROGRAMME OF EXPERIMENTS EXECUTED.

I. Between May 30 and June 1, 1889, the engine was run continuously 72 hours under its usual working conditions, and measurements made of

a. The coal consumed, anthracite, stove size, being used.

b. Horse power performed both for pumping the water and to overcome the friction of the engine itself.

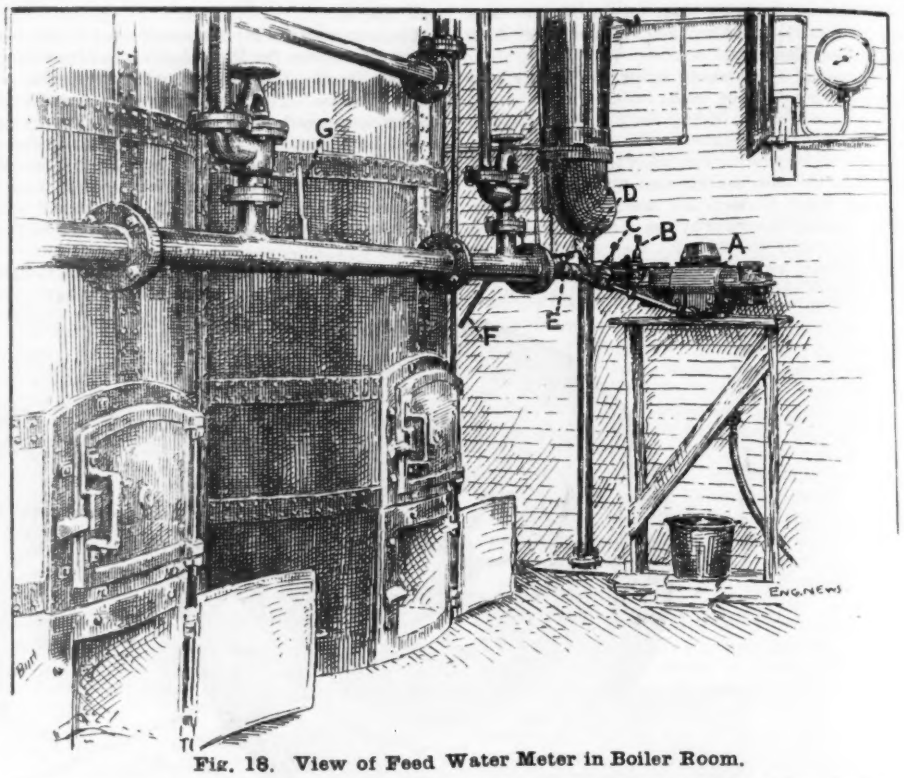


Fig. 18. View of Feed Water Meter in Boiler Room.

c. The pounds of steam generated in the boilers and used to operate the engine.

d. The pounds of water used to condense the steam as it left the engine.

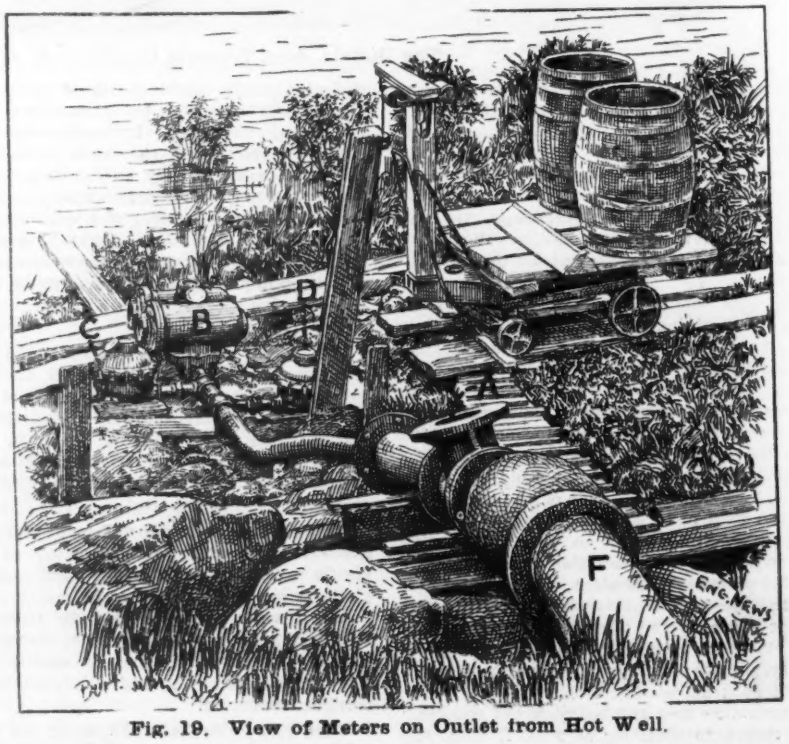


Fig. 19. View of Meters on Outlet from Hot Well.

e. All temperatures and detailed measurements necessary to determine the heat rejected by the engine, the steam condensed in the jackets, the economy due to passing the condensed steam from the receiver through heater in chimney, and the dryness of the steam.

f. The duty of the engine, the steam per hour per horse power, and the evaporation of the boilers per pound of coal, were the principal quantities sought.

II. Between June 1 and June 2, the engine was run 24.13 hours under the same conditions as before, but with selected George's Creek bituminous coal for fuel.

The same determinations were made, but the special object was to check the previous test and at the same time ascertain how much gain in duty could be expected from choice bituminous coal as compared to the stove anthracite used in the first test, and in the usual operation of the plant.

III. Between June 3, 1889, and June 5, 1889, short tests of from six to nine hours were made, the engine being run with and without steam in its steam jackets. No measurement of fuel was made, the object sought being to determine the steam consumed by the engine per horse power with and without the jackets in action.

The rare degree of uniformity of conditions available for these several tests is shown by the steam indicator cards Figs. 20 and 21. The average pump cards are represented in Fig. 22. The boiler pressure averaged 127 lbs. with an extreme variation

*Funds for defraying the expenses of this investigation have been cordially contributed by the Trustees of the Stevens Institute and Messrs. Joel Sharpe, A. C. Humphreys, H. C. White, A. P. Trautwine, W. W. Daggetts, and the Alumni Association of the Stevens Institute.

**The sectional view of the engine in this figure is shown to the same scale as the section of the Cornish engine used by Wicksteed. As it happens that the two engines are nearly the same H.P. and capacity, a comparison of the area of the sections affords a good idea of the enormously greater cumbersomeness of the Cornish type

of 2½ lbs. either way. The range of average water pressures was only from 115 to 118 lbs. per square inch, and the maximum and minimum pressure differed less than 4 lbs. in each test. The range of average speed was only from 48.95 to 49.5 revolutions per minute. About 250 indicator cards were collected during the tests and used in working up results.

PREPARATIONS FOR THE TESTS.

These consisted of the following steps:

a. The insertion of a water meter in the line of the feed pipe delivering water from the hot well to the boilers.

b. The insertion of a group of three water meters in the line of exhaust pipe leading from the hot well to the river into which the water wasted.

c. The insertion of thermometers into mercury-filled ferrules; the latter being screwed into the steam and water pipes at various places.

d The testing and sealing of the scales upon which the coal was weighed.

Means for securing indicator cards, recording the revolutions, testing pressure gauges, etc., of the most satisfactory character, already existed at the station.

The arrangement of the feed-water meter is shown in Figs. 17 and 18. *A* is the meter arranged between two branch pipes which lead out of the main feed pipe at right angles to the latter, through the two valves *C* and *B*.

Between the latter is another valve *D*, lying in the line of the main feed pipe. By closing valve *D* and opening *C* and *B*, the feed water was forced to travel through *B* and the meter *A*, and regain the main feed pipe through *C*. Thence it passed into the boilers through the vertical valves leading upward out of the large horizontal pipe running along the front of the boilers. *G* is the thermometer which measured the temperature of the feed water as it entered the boilers. Should any accident befall the meter, valves *C* and *B* could be instantly closed and *D* opened, thereby returning the feed system to its normal condition.

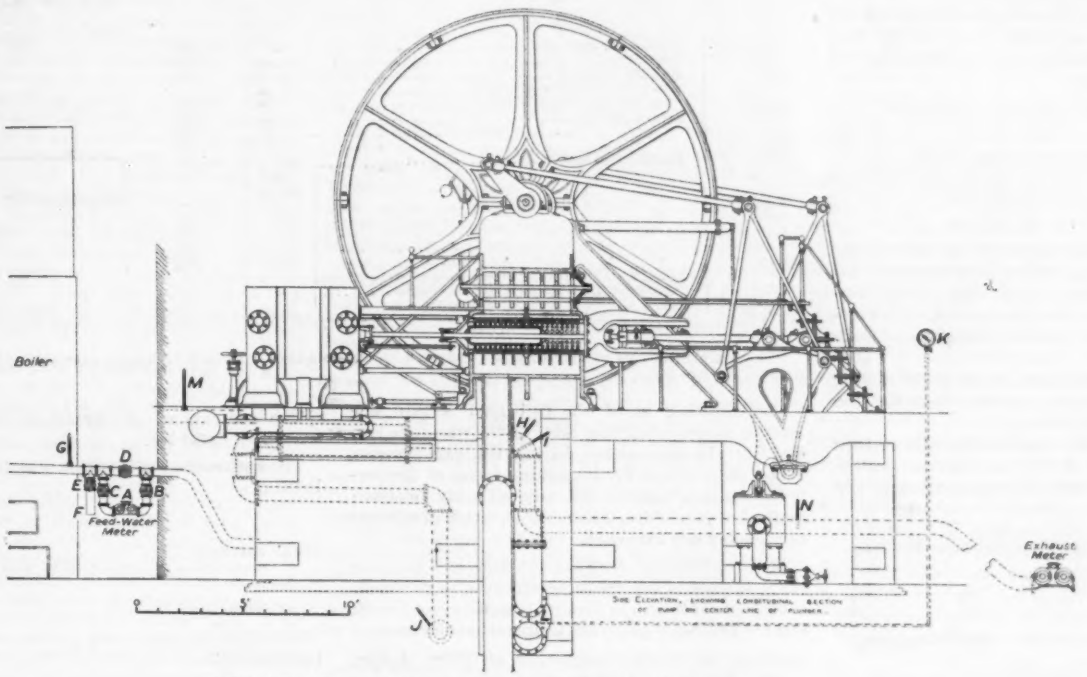
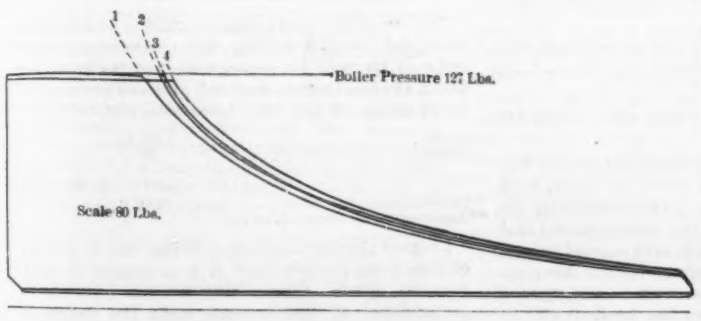
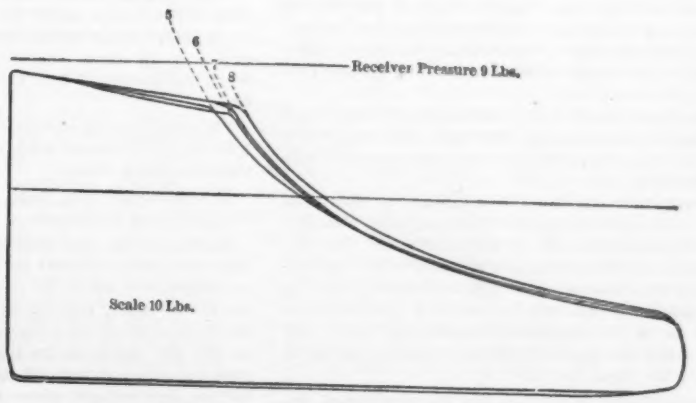


Fig. 17. General Arrangement of Plant and Apparatus.



No. 1, 72 Hour Test. Cut off 0.220 } With Jackets.
" 2, 24 " " " " 0.235 }
" 3 6 " " " " 0.242 } Without Jackets.
" 4, 9 " " " " 0.228 }

Fig. 20.



No. 5, 72 Hour Test. Cut off 0.310 } With Jackets.
" 6, 24 " " " " 0.3345 }
" 7, 6 " " " " 0.335 } Without Jackets.
" 8, 9 " " " " 0.350 }

Fig. 21.

VALUE AND TEST OF METER.

The use of a meter to measure the feed water had the advantage of disturbing none of the conditions of regular working. If the hot well water had been run into weighing tanks, a separate pump would have been necessary to feed it to the boilers; and in handling the steam to run this pump, the temperature of the feed water and quantity of steam generated per unit of time, etc., etc., would have been altered from their normal conditions.

The Worthington meter, once calibrated or rated, does not change its rate, with clean water, within any interval such as is consumed by tests, and it is much more satisfactory for night and day continuous work than any human labor which could be assigned to the weighing out of tanks. The rating of the meter was, in the present case, performed as follows:

The valve *E*, Fig. 18, was closed, and a valve (not shown) opened so that the water passing the meter all escaped by a nipple *F* which led off from the feed pipe between the valves *E* and *D*. From *F* a hose was led to four barrels holding about 5½ cu. ft. each. The first few seconds' flow from *F* was led into a pail, until the meter read an integral number of cubic feet. It was then switched into the first barrel, and by watching the increase of weight each ten seconds, the valve on *F* could be adjusted in 30 seconds, so that water flowed at the same rate as when feeding the boiler. From 10 to 20 cubic feet, as shown by the meter were then collected in the barrels and weighed, thus rating the meter under the *conditions* which existed while the boiler was being fed. The following table gives the results of such tests:

TESTS OF 1-INCH WORTHINGTON FEED WATER METER.

Date.	*Cu. ft. registered by Meter.*		*Weight per cu. ft., lbs.*
May 27	10		60.25
		first 5	60.00
		second 5	60.04
May 31	20	third 5	60.00
		fourth 5	60.40
		av. of all 4 barrels	60.40
May 31		total weight 4 bls.	60.31
June 1	15 cu. ft.		60.40
Average			60.375

The group of meters for measuring the hot well water are shown in Fig. 19 at *B*, *C*, and *D*. Two are 2-in. Crown meters and the middle one a 3-in. Worthington meter. *F* is the end of the hot well

discharge pipe as ordinarily used, and from thence to the meters is the temporary extension for the purposes of the test. *A* is an air-hole or vent to prevent the passage of air through the meters. The temperature of the water, when it reached the meters, did not exceed 90° Fahr., so that no trouble was experienced in operating the Crown meters. The flow of water was very uniform throughout the test. A slight amount of vapor escaped at *A*. As these meters were only under the pressure due 8 ft. of fall from the point *F* to the river, they could be tested in the ordinary way.

This was done at the testing room of the Pawtucket Water Works. The result showed that the Worthington meter registered 1 cu. ft. for each 62.0 lbs. at 90° Fahr. and each of the Crown meters 1 cu. ft. for each 63.4 lbs.

General Arrangement of Apparatus.

Referring to Fig. 17, thermometer *G*, and the meters, valves, etc., are the same as in Fig. 18. All thermometers were made by HENRY G. GREEN of N. Y., and were calibrated for the test.

QUALITY OF THE STEAM.

Thermometer *M* was a special one 36 in. long, Twenty inches of length were devoted to 100° between 300° and 400° Fahr. Each degree was therefore represented by one-fifth of an inch, thus making the temperature of the steam measurable with great accuracy.

This thermometer remained at about 356° during most of the experiments, thereby showing the steam to be superheated about 3°.

The quality of the steam was therefore determined to be practically exactly "dry" or saturated on entering the engine; without the application of the

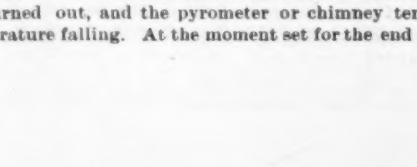


Fig. 22. Pump Cylinder.

more or less vexatious devices known as calorimeters, for the use of one of which, the Barrus superheating form, arrangements had been made.

The thermometer *J* determined the temperature of the water from the suction well on its way into the condenser.

Thermometers *H* and *I* measured the temperature of the water leaving the condenser, *H* extended just through the pipe, and *I* to nearly the opposite side of the pipe.

The former constantly showed about 102° when the latter read about 92°. This apparent anomaly was finally explained by the conclusion that the thermometer *H* showed the temperature of saturation of the steam or vapor at the pressure given by the vacuum gauge, 28½ ins., while *I* gave the temperature of the mixture of condensed water and condensed steam which confined itself to the lower side of the pipe.

Thermometer *N* showed the temperature of the hot-well water. Its readings were practically identical with those of *I*, and practically with those of *G* when the latter were not influenced by the entrance of the condensed steam from the jackets into the feed pipe. Such steam was pumped into the feed pipe at a point just below *M*.

MANNER OF COMMENCING AND ENDING THE FIRST TWO TESTS.

The engine being at work under its regular conditions of about 127 lbs. boiler pressure, the steam pressure was allowed to fall by deadening the fire, until it reached about 100 lbs. The engine was then stopped and the fire drawn, the grates and ash pits being cleaned as quickly as possible. A new fire was then laid with a weighed quantity of wood, and as soon as the steam pressure was 130 lbs., the engine was started and the test was under way.

The water level in the boilers was noted at the time of lighting the new wood fire. At the time allotted to the test, steam was brought to as nearly as possible the pressure at which the wood fire was lighted, and the water level was also made the same. Care was also taken that the fire was well burned out, and the pyrometer or chimney temperature falling. At the moment set for the end of the test, the engine was stopped, and the fire drawn and weighed.

To illustrate how little time is lost in starting a test in the above manner, the following abstract from the log is given:

WEDNESDAY, MAY 30, 1889. COMMENCEMENT OF 72 HOUR TEST.

Time.	Remarks.	Vac. / Receiver	Boiler Pressure.	Height * of water with reference to a mark on glass 4 ins. above bottom of latter. 1st Boiler	2nd Boiler.	3d Boiler.
8.05 A.M.	Ceased firing		125	0	½ in.	2
8.40 "	Drew fires		110	0	0	0
8.45 "	Engine stopped		105	"	"	"
	Ash pit and grate cleaned					
9.22 "	New fire lighted-263 lbs. wood		102	— 1½ in.	— ¾in.	— 1¾ in.
9.29 "	Steam rising		112	— 1	— "	— 1⅜
9.30 "	"		120	— ¾	— "	— ⅞
9.32 "	"		130	— ½	— ½	— ½
9.34 "	Engine started					
9.35 "	" under full load 29 "	5 lbs.	"	Pyrometer 410°		
9.40 "	" " "	5¼	128			
9.45 "	" " "	7	127			
9.55 "	" " "	8	125			
10.00 "	" " "	8	128			
	1350 lbs. of small coal or screenings were in the furnace and ignited at this time.					

It was determined by the meter and confirmed by estimate that each inch of height represented ¾ of a cubic foo of water at 100° Fahr.

The throwing on of the full load within one minute is accurately the fact. This was done several times in my presence during the experiments.

The use of a new fire in making a test of the performance of a boiler is the only perfectly accurate method of procedure, unless the duration of the test is to exceed say 100 hours.

To start without drawing the fires, and trust to the judgment of the eye to determine an equivalent condition at the end of a short test, may involve an error of ten per cent. in the evaporation efficiency.

METHOD OF FIRING, SELECTION OF FUEL, ASHES, CLINKERS, ETC.

Three boilers were used. The grate surface in each boiler was a circle 4½ ft. in diam. and 15 sq. ft. in area. Each boiler was a cylinder 14 ft. long and 4 ft. in diam. suspended vertically in brick work and having 48 3-in. tubes running from end to end.

The total heating surface in the three boilers was 1,231 sq. ft. in contact with water, and 508 sq. ft. of superheating surface.

The boiler flues had been swept clean about five days previous to the tests.

As soon as the fires were evenly ignited, the fireman was limited to 200 lbs. of coal per hour, with an extra allowance of 100 lbs. for cleaning every six hours. So nicely was the firing under control that the furnace doors were scarcely ever opened to look at the fire between the hours. As the hour approached, the allotted 200 lbs. were loaded upon a barrow and brought close to the fire-door of one boiler. The damper of this boiler was then closed, the fire-door opened, and one-third of the barrow-load, quickly but accurately distributed evenly over the grate. The same operation was repeated with the other boilers. Each fire-door was open less than a minute. When the fires were cleaned, the engineer assisted the fireman, one using the slice bar and the other withdrawing the cinder. The cleaning, including the addition of one-third of the allotted 100 lbs. of extra coal, was accomplished in a little over three minutes for each furnace. On several occasions the whole of the 100 lbs. of cleaning coal was not required. The above refers to the 72-hour test, during which the fuel was mainly stove anthracite. It is the practice of the station to screen this coal on a 1-inch square mesh, thereby freeing it of all small pieces of the size equivalent to "nut" coal. The small size, or that which falls through the screen, is used for starting and banking the fires, while the larger or stove size is used for the bulk of the work. The small screenings were used in starting the fires in the 72-hour test, up to about ten o'clock, as indicated on the above abstract of the log.

The refuse of the anthracite coal collected in the ash pit was 751 lbs. This was screened through a ⅝-in. mesh, and 110 lbs. of unburnt coal obtained. This coal was put on the fire during the last or seventy-second hour of the test, after the firing with fresh coal had ceased.

The clinkers removed during the cleaning of fires amounted to 653 lbs.

The contents of the grates at the end of test amounted to 944 lbs.

The anthracite coal account was, therefore, as follows:

	Lbs.	Lbs.
Total coal fired	15,710	
" wood taken as equivalent to 4-10 as much coal	105	
Total fuel		15,815
Consumption per hour	219.5 lbs.	
Incombustible:		
From ash pit	641	
Clinker	653	
Left in furnaces	944	2,238
Total combustible		12,577

Total refuse equals 14.3 per cent. of fuel.

The bituminous coal made no clinker and the fires were not cleaned during the entire twenty-four hours of its use. No separation was made of the ashes, the total refuse from ash pits and grates combined being 510 lbs. The total consumption was:

Coal	5,200 lbs.	
Wood	80 "	
	5,280 "	in 24 hours.
Consumption per hour	218.6 "	

Ashes equal 9.6 per cent. of fuel.

I regard the above details of firing, etc., as worthy of note, from the fact that it is a matter of well-founded opinion that a very sensible part of the performance of fuel depends upon the degree of skill displayed in firing, when the best results are attained. It is beyond doubt that the extraordinary annual performances of the Pawtucket Pumping Engine are partly due to the high state of efficiency to which the routine firing and other details of management have been brought by Chief Engineer WALKER'S zeal and intelligence.

Comparative Efficiency of Non-Conductors.

The Boston Manufacturers' Mutual Fire Insurance Co., EDWARD ATKINSON, President, have issued the following Special Circular No. 27, which we slightly abridge, on the above subject. It appears to show that slag wool or mineral wool is practically about the best non-conductor:

A few years since, a very exhaustive investigation was made at the instance of the Boston Manufacturers' Mutual Fire Insurance Co. by Prof. JOHN M. ORDWAY, then of the Massachusetts Institute of Technology, upon the non-conducting properties of various materials, some of which may be used for covering steam pipes and boilers, while others, owing to their liability either to become carbonized or to take fire, cannot be directly applied to such use.

There are, however, other problems in preventing either the escape of heat or the ignition of woodwork by

the impact of heat, for which purposes various substances are or may be offered. It may not be assumed that because a given material is incombustible, it is, therefore not a quick conductor of heat. Neither may it be assumed that because a material is a quick conductor of heat, it may not be made use of in some cases for protection against fire.

For instance, given the problem of making a fire door. If the door be made of two thicknesses of solid wood, so adjusted each to the other as not to be liable to warp, this door may be encased in sheet-iron or tinned plates with the joints carefully locked, and it will become a good fire stop, although both the sheet iron and tin plate are good conductors of heat. The reason of this is, that while the wood, which is in immediate contact with the metal, will be carbonized, yet even the sheets of hot metal, if thoroughly locked, and therefore thoroughly encasing the wood, keep out the oxygen; then, for want of sufficient air to ignite the carbonized wood, the door remains solid and strong for many hours. Thin plates of tinned iron or steel serve this purpose, where thick plates would warp or bend under heat so as to fail in keeping the doorway tightly closed. Iron doors and shutters are often worse than useless, owing to this tendency to warp or bend, opening a way for fire while obstructing the firemen; also because when heated they do not serve as a guard near which firemen may protect adjacent woodwork. Zinc is worthless as a fire stop because of its very low melting point. If the door is tinned on one side only, it may be burned about as quickly as if there were no tin upon it, although it may not be ignited quite so soon.

On the other hand, let it be assumed that this same wooden door was encased in asbestos made in thin sheets and strengthened in some way so as to serve the purpose,—yet this covering would be of no value. Asbestos is incombustible, but it is rather a good conductor of heat, as will appear from the subsequent tables; also being porous, so that a free passage of air may be given through the interstices, it will wholly fail to prevent a wooden door or surface of wood from being quickly consumed, when laid on in thin sheets or put between floor plank and boards.

In order that the relative merits of the different substances which are offered to our members for preventing the escape of heat from boilers and steam pipes, or as substitutes for wire lathing and plastering, or for tin-plates in the protection of elevator shafts, or of woodwork nailed closely to walls, the following tables are submitted. These tables and extracts are taken from a later report made by Prof. ORDWAY. It will be observed that several of the incombustible materials are nearly as efficient as wool cotton and feathers, with which they may be compared in the following table. The materials which may be considered wholly free from the danger of being carbonized or ignited by slow contact with pipes or boilers are printed in Roman type. Those which are more or less liable to be carbonized are printed in italics.

Prof. ORDWAY'S report is as follows: "Careful experiments have been made with various non-conductors each used in a mass 1 in. thick, placed on a flat surface of iron kept heated by steam to 310° Fahr. The following table gives the amount of heat transmitted per hour through each kind of non-conductors 1 in. thick, reckoned in pounds of water heated 10° Fahr., the unit of area being 1 sq. ft. of covering.

Substance 1 in. thick. Heat applied, 310° Fahr.	*Lbs. water heated 10° Fahr. per hour through 1 sq. ft.*	*Per cent. Solid matter.*
1. *Loose wool*	8.1	0.56
2. *Live geese feathers*	9.6	0.50
3. *Carded cotton wool*	10.4	0.20
4. *Hair felt*	10.3	1.85
5. *Loose lamp-black*	9.8	0.56
6. *Compressed lamp-black*	10.6	2.44
7. *Cork charcoal*	11.9	0.53
8. *White pine charcoal*	13.9	1.19
9. *Anthracite coal powder*	35.7	5.06
10. Loose calcined magnesia	12.4	0.23
11. Compressed calcined magnesia	42.6	2.85
12. Light carbonate of magnesia	13.7	0.60
13. Compressed carbonate of magnesia	15.4	1.50
14. Loose fossil meal	14.5	0.60
15. Crowded fossil meal	15.7	1.12
16. Ground chalk (Paris white)	20.6	2.53
17. Dry plaster of Paris	30.9	3.68
18. Fine asbestos	49.0	0.81
19. Airalone	48.0	0.00
20. Sand	62.1	5.27

There are some mixtures of two materials which may be quite safe, although consisting in part of substances which may be carbonized. It must also be considered that a covering for a steam pipe or boiler should have some strength or elasticity, so that, even when put on loosely and holding a great deal of entrapped air, it may not be converted into a solid condition by the constant jar of the building, then becoming rather a quick conductor. This warning may be applied especially to what is called "slag wool," which consists of short, very fine threads of a brittle kind of glass. The following table has been submitted by Prof. ORDWAY, with the accompanying explanation:

"The substances given in the following table were actually tried as coverings for 2 in. steam pipe, but for convenience of comparison, the results have been reduced by calculation to the same terms as in the foregoing table.

Covering.	*Pounds of Water heated 10° F., per Hour by 1 sq. ft.*
21. Best Slag Wool	13.
22. Paper	14.
23. Blotting Paper wound tight	21.
24. Asbestos Paper wound tight	21.7
25. Cork strips bound on	14.6
26. Straw Rope wound spirally	18.
27. Loose Rice Chaff	18.7
28. Paste of Fossil Meal with Hair	16.7
29. Paste of Fossil Meal with Asbestos	22.
30. Loose Bituminous Coal Ashes	21.
31. Loose Anthracite Coal Ashes	27.
32. Paste of Clay and Vegetable Fibre	30.9

"Later experiments, not yet published, have given results for still air which differ little from those of Nos. 3, 4, and 6. In fact, the bulk of matter in the best non-conductors is relatively too small to have any specific effect, except to entrap the air and keep it stagnant. These substances keep the air still by virtue of the roughness of their fibres or particles. The asbestos of 18 had smooth fibres, which could not prevent the air from moving about. Later trials with an asbestos of exceedingly fine fibre have made a somewhat better showing, but asbestos is really one of the poorest non-conductors. By reason of its fibrous character it may be used advantageously to hold together other incombustible substances, but the less the better. We have made trials of two samples of a "magnesia covering" consisting of carbonate of magnesia with a small percentage of good asbestos fibre. One transmitted heat which, reduced to the terms of the first of the above tables, would amount to 15 lbs.; the denser one gave 20 lbs. The former contained 250 per cent. of solid matter; the latter 396 per cent.

"Charcoal, lamp-black, and anthracite coal are virtually the same substance, and Nos. 5, 6, 7, 8, and 9 show that non-conducting power is determined far less by the substance itself than by its mechanical texture. Any suitable substance which is used to prevent the escape of steam heat should not be less than an inch thick.

"Any covering should be kept perfectly dry, for not only is water a good carrier of heat, but it has been found in our trials that still water conducts heat about eight times as rapidly as still air."

Hazard from Outside Electric Currents.

The Boston Manufacturers' Mutual Fire Insurance Co. has issued the following Special Circular, No. 28, as to protection against these risks, showing what is no doubt the best system of protection against these dangers:

Electric lighting was first introduced in a very few risks insured by this company before the year 1881; in that year, and in the first six months of 1882, it was adopted in a very considerable measure. In this period of its early introduction, prior to April 1, 1882, we received notice of twenty-three fires which had been set by the electric current in only sixty-one miles which had then been equipped. No claim for loss was made in any of these fires, but they disclosed conditions which were very alarming to us. An immediate investigation was made, under the direction of Mr. C. J. H. WOODBURY, and certain rules were adopted for putting up the apparatus, insulating the wires, and guarding against the dangers disclosed in these twenty-three fires. These rules were immediately submitted to all the electric light companies or manufacturers of electric lighting apparatus who had any standing in the community, and were at once adopted by them as well as by all insurance companies. They have not been changed since that date except so far as new inventions have called for modifications.

Since April 1, 1882, a period of nearly eight years, we have received no notice of any fire which could be attributed to electricity in any risk insured by this company, and of course no claim has been made upon us for a loss which could be attributed to this cause. Our experience, therefore, justifies the conclusion to which we came after the first two years of electric lighting,—that under proper safeguards it is the safest method of lighting that can be introduced. Electricity has also been applied in some of the works insured by us as a motive power, and electricity is now applied to lighting or motive power in over 600 risks which are insured by the Factory Mutual Companies.

Attention, however, has lately been called to the danger of wild currents of electricity generated on the wires which may be in use for lighting, for power, and for the railway service in many cities. There appears to be very little doubt that the recent destructive fire in Boston originated in the diversion of a high-tension current of electricity from its own wire to an electric clock wire, on which it was carried to the building in which the fire originated. There appears to be little doubt that this conflagration may be attributed to the lack of precaution in guarding against an outside current of electricity. Such currents may be carried from their proper wires to other points in all cities or towns in which electric light or power is widely distributed in the public streets or over private buildings.

In order to guard against this hazard, the owners and managers of mills and works insured are advised to establish the following rules for the protection of their premises. These rules, after having been drawn by us, have been submitted to experts in various branches of electric science who are of the highest authority. The forms have been modified by them, again considered on our own part, and are believed to be suitable for what may be called an emergency.

The following are the rules of the Boston Manufacturers' Mutual Fire Insurance Co., for guarding insured property against the hazard of stray currents of electricity generated outside of mill yards:

1. No foreign wires of any kind shall be attached to buildings insured by this company, for the purpose of carrying electric currents across the yard to any point.

2. All electric wires which may be required by the insured shall enter the premises at one point near the headquarters of the night watchman, where they can be kept under supervision; each of said wires shall be guarded by a protector against strong currents, operating by opening the circuit, and by a lightning arrester.

3. Such protectors against strong currents shall be located, in a dry accessible place, inside the building, and as near the point of entrance of wires as possible, and shall be without ground connections; such protectors shall be mounted on non-combustible and insulated supports, which shall be provided with a receptacle for the burning of melted parts of such apparatus.

4. The lightning arresters on all wires must be placed between the protector against strong currents and the electrical portion of the apparatus within the building to which such wires are connected. No ground wires for such lightning arrester shall be attached to gas-pipes within the premises of the insured.

5. All electric wires which may enter the premises of the insured must be insulated between the line wire on the insulator attached to the buildings outside and the protection device within, with the best quality of waterproof insulation. Moreover, such wires must enter at a distance of not less than 3 ins. from any other wire or any conducting material.

6. If any wires carrying high tension or strong currents are to be carried over or under other wires on the property of the insured, they shall be attached to poles so near to each other, with one wire so far above the other, that if a break should occur, the pendent wire between these poles may not be long enough to come in contact with the wire below, or, if not carried on poles, these wires shall be so placed or protected with guard-wires as to render a contact between different wires impossible.

7. If the high and low tension systems are in use in the same yard, even when developed within the works, the wires must be kept separate, and so wide apart that no contact or cross arc can be made.

A PARIS PROJECT TO ECONOMIZE IN POTABLE WATER is to establish throughout Paris a complete double distribution system, reaching all floors of buildings. One system would convey the potable water for drinking, cooking, etc., the other water from the Seine for ordinary use. Mr. BECHMAN, Chief Engineer of the Paris Department of Health, points out that three systems of distribution would really be needed; a third being demanded for the economic use of Seine water on the streets, in the sewers, etc. The pressure required for this latter service would not be so great as that for house use. This third system would demand 620 miles of pipes and perhaps the enlargement of certain sewers, and the estimated cost is $6,000,000. The expense to householders for the additional service would raise the expenditure to $9,600,000; and with the different reservoirs, pumps, etc., required the total cost would be nearly $20,000,000. To obtain sufficient additional potable water from new sources to meet all demands would cost only $7,000,000, says Mr. BECHMAN in *Le Genie Civil*.

Tests of Brake Shoes.

The Master Car Builders' committee to report at the Old Point Comfort convention in June, on the relative merits of metals for brake shoes, invites manufacturers to submit samples of their shoes for the following tests, which if carried out with the thoroughness which may be expected from tests under the direction of the chairman of the committee ought to shed some needed light on this question:

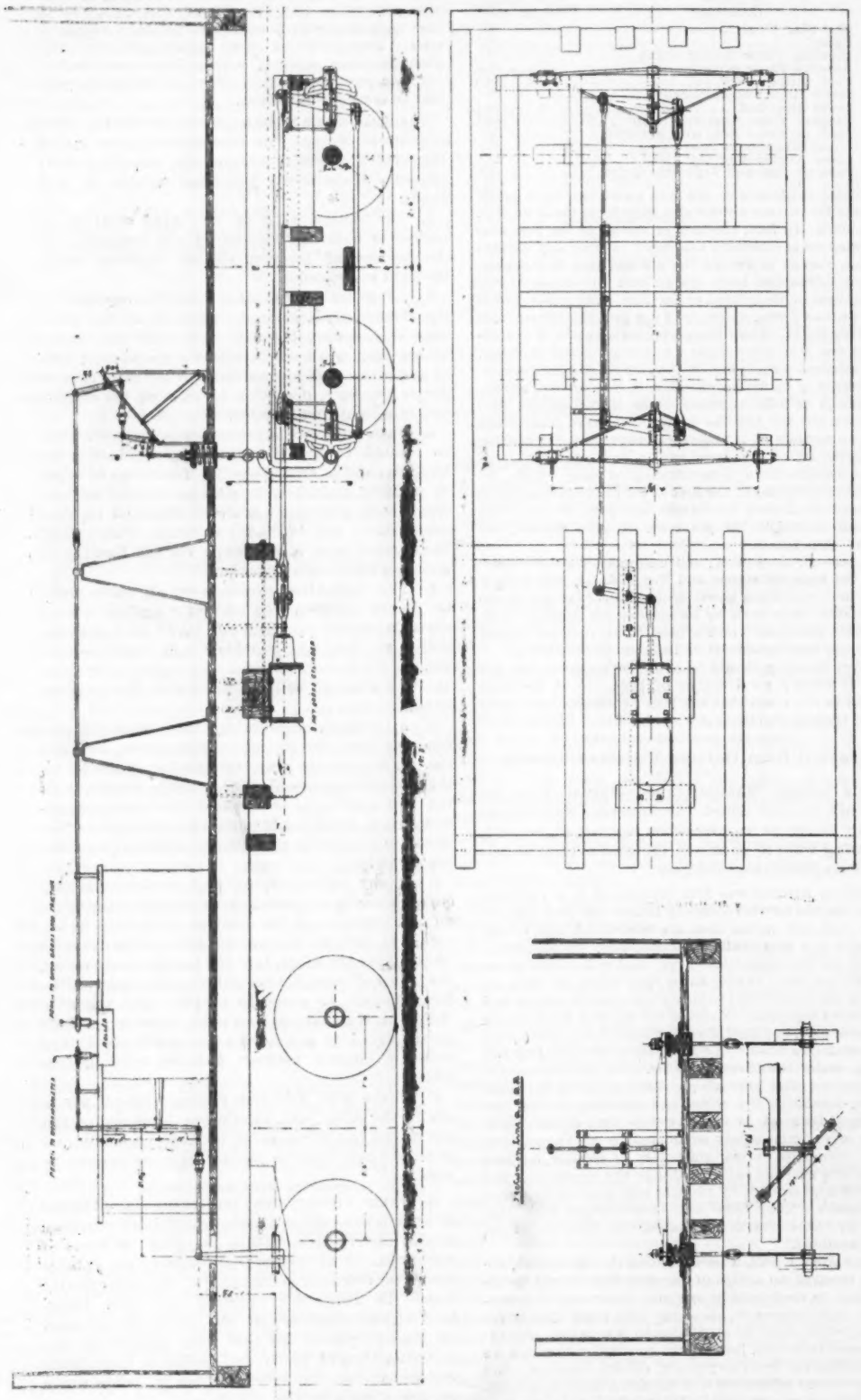


Fig. 2. Apparatus for Measuring Brake-Shoe Friction.

TESTS.

1. One series of tests to be made with a standard coach fitted with four-wheel trucks, Westinghouse quick action brake and eight wheels braked. This series to be divided into two parts, one consisting of a series of tests made with 33-in. steel-tired wheels with treads turned cylindrical, the other to be made with 33-in. chilled wheels ground cylindrical.

2. A second series of tests will be made with a dynamometer car also fitted with quick-action brake, with 33-in steel-tired wheels and chilled wheels turned and ground as above, but with brakes applied to but four wheels, all on one truck.

3. The tests will be made on a level tangent at twenty and forty miles per hour.

4. The locomotive will be equipped with the Boyer speed recorder, an electric bell to the car, and will push the car to the required speed in each test.

5. Each test will be repeated six times, the car to carry the same load in each test.

6. The brake beams will be the M. C. B. standard iron beam for 15,000-lb. load, as illustrated on plate XII, M. C. B. annual report, 1889. The beams will be hung from the truck frames by Sargent's adjustable swivel hanger (Fig. 1.)

7. Brake shoes will be of the dimensions and design given on plate XII. of the M. C. B. annual report. It is important that the dimensions be accurately conformed to. The shoes will hang ¼ in. from the tread of the wheel when brakes are off, and will be so adjusted that when they are brought against the wheel they will bear on the whole surface before power is applied. The shoe must be furnished to the committee accurately ground or turned to fit a 33-in. cylinder.

8. The diameters of the journals will be the same for all tests, and the sponging and oiling of boxes will be maintained as uniform as possible.

9. Brake leverages and pressures will be constant with each car for all tests. To avoid the possibility of slipping wheels the pressure of the shoes on the wheels must not exceed 70 per cent. of the weight of the wheels on the rails.

APPARATUS TO BE USED IN THE TESTS.

10. To accurately measure the speed the Boyer speed recorder will be used on the locomotive. When the dynanometer car is used the speed recorder therein wil also be used to check the results of the Boyer speed recorder.

11. In the coach tests the length of stop will be measured from the point of application to the center of car. The point of application must be as nearly as possible at the same point for each test. The figures will be taken from track stakes placed at 50 ft. intervals, and properly marked. The dynamometer car will be fitted with apparatus for recording the length of each stop.

12. The pressure in the auxiliary reservoir and brake cylinder to be recorded before and during each stop.

13. The velocity of the wind and the condition of the rail must be noted in each case together with any unusual variation in the conditions, which should be as nearly constant as possible.

14. In the case of the dynamometer car, an apparatus as shown in Fig. 2 will be used for measuring the friction of the brake shoes at all times during the application of the brake.

15. Parties intending to furnish shoes for these tests should communicate with the chairman of the committee not later than March 1, and as much earlier as possible. If any large number of competitors signify their intention of furnishing shoes, it may become necessary for the committee to make modifications in their plans on account of the time necessarily occupied in each test.

16. The committee reserve the right to make such additions and modifications to these tests as further consideration of the subject may suggest.

G. W. RHODES.
E. B. WALL,
B. K. VERBRYCK,
Committee.

Test of the Aveling & Porter Road-Roller.

At the request of Mr. WILLIAM C. OASTLER, the representative of the Aveling & Porter Co., Col. JOHN Y. CUYLER, EDWARD P. NORTH and ALBERT F. NOYES, all members of the American Society of Civil Engineers, and engineers experienced in the construction and maintenance of roads, made a series of tests of steam road-rollers of two different makers, with the purpose of comparing their general efficiency when working under conditions as nearly alike as possible. An abstract of this report here follows, confined, however, to the portions relating to the Aveling & Porter roller:

The first series of tests was made at Pawtucket, R. I., with two 15-ton steam rollers of the above make, placed at the disposal of the committee through the courtesy of the Highway Commissioners of Pawtucket and Central Falls. The report then continues:—

The roller was owned by the city of Pawtucket, and had been in constant use for four seasons. The second roller, owned by the city of Central Falls, R. I., was purchased this season. The first test was made on Walcott St., Pawtucket, between North Bend St. and Prince St. The grade of the street was slightly rising toward Prince St. The hard gravel surface of the old roadbed had been picked up and covered with a coating of stone 2 to 4 ins. in diameter, screened from gravel, 6 ins. to 8 ins. in depth. The coal used in all cases was about the same quality of Cumberland bituminous.

The first test was made with the Pawtucket roller, No. 2143, made in 1886, and operated by the local engineer to determine how quickly an area 238 ft. long and 19 ft. wide, which had not been rolled at all, could be rolled Six round trips were made over this distance, 2,858 ft. in all, rolling for the first time 4,522 sq. ft. in 14 minutes. which includes the time of stopping, reversing and starting. At the commencement the steam gauge stood at 120 lbs.; at the end of the second trip it had run to 100 lbs. From this on, the pressure increased with considerable regularity to 138 lbs. at the end.

The second test was made with roller No. 2519, made in 1889, and owned by the city of Central Falls, R. I. The area covered by this test was 240 ft. by 19 ft. Th

roller was operated by Mr. MARTIN, an engineer of the Aveling & Porter Co. Eight round trips were made over this course in thirteen minutes, making the total distance run 3,840 ft., and the area covered 4,560 sq. ft. The roller, which had been standing for over half an hour, had a dead fire in it, and the pressure ran down from 105 lbs. at starting to 95 lbs., and at the end of the test was 110 lbs. This was re-rolling the same area rolled in the previous test. The amount of the consolidation of the road-bed by even this slight rolling shows the value of rolling stone roads with a steam road roller, for during the second test heavily loaded teams passed over the road without making any appreciable impression on the surface.

The third test was made by roller No. 2519 with picks in one wheel on Mill St., between Central Falls upper

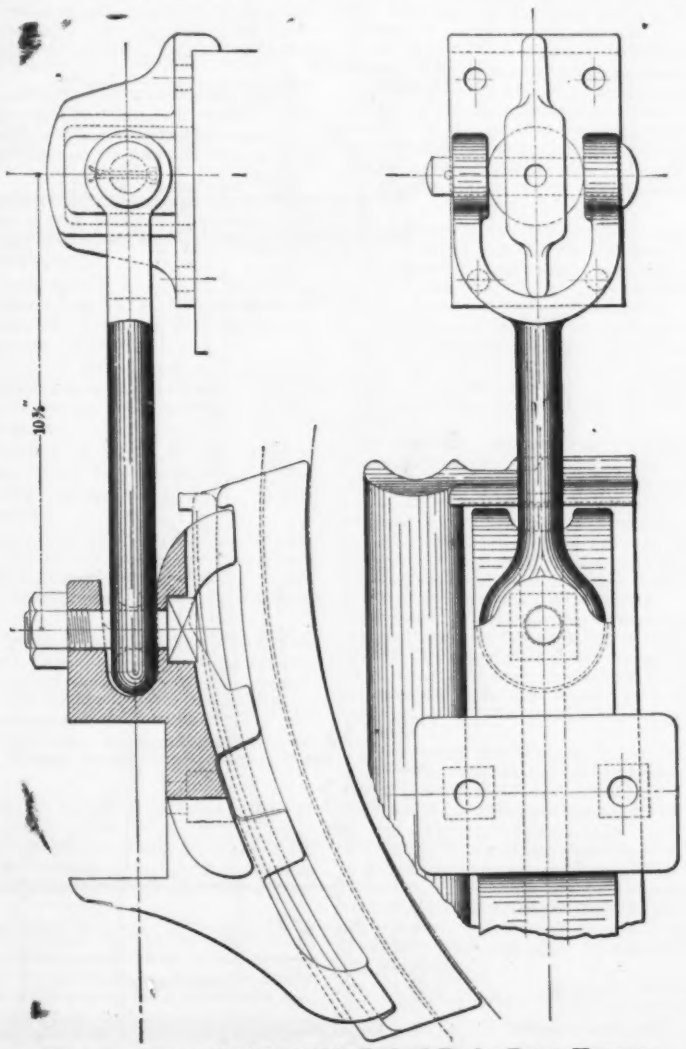


Fig. 1. Sargent's Adjustable Swivel Brake-Beam Hanger.

Bridge and Grand Sts., which has a grade of 7 per cent. The strip available was 7 ft. wide between the paving in the gutter, and on the side of the horse railroad track. The log of steam pressures in detail was as below. Starting at bottom of hill, gauge 95 lbs., at top 90 lbs.; on returning to the bottom of the hill the gauge stood at 100 lbs. and raised to 105 lbs. while waiting for a team, and stood at 108 lbs., at the top; at the bottom again it stood at 120 lbs., and at the top it had fallen to 108 lbs., going up to 120 lbs. at the bottom. Three round trips in all were made, thoroughly picking up 2,190 sq. ft. in area.

After this the fourth test was made, the picks having been taken out; roller No. 2519 hauled roller No. 2143, both being 15-ton rollers, up the other side of the same street and around a curve of about 52 ft. radius. Roller No. 2143 was thrown out of gear, but was steered by its driver. The steam pressure at the start was 110 lbs.; at the curve, a distance of 313 ft., it was 112 lbs.; at the end of the trial, 480 ft. from the curve and involving 250 ft. additional of 7 per cent. grade, the pressure was 109 lbs. Distance, 793 ft.; time 1¼ minutes, or at the rate of 3.4 miles per hour. During this test, and in fact in all others, the fires were not cut by the blast and the smoke stack did not throw out cinders, nor was there any accumulation of cinders in the smoke box at the end of the test. The roller drew its load up this 7 per cent. grade without faltering, and though one or the other of the driving wheels was often on the cobble-stone pavement, there was no slipping.

After this the pin was drawn from one wheel and the roller turned in a circle of 39 ft. outside diameter. Then, to show the efficiency of the roller in plowing up hard roads, a heavy plow, cutting 7½ ins. wide and 14 ins. deep was attached to roller No. 2143 and easily drawn for one hundred or more feet, beam deep, through a hard stone and gravel road, breaking it up thoroughly. It might be mentioned in this connection that Mr. ALLEN, the Highway Commissioner of Pawtucket, said no money had been expended in repairs of roller No. 2143. A drawing bar had been attached for plowing and scraping, and a cab built.

The "Bag-System" of Refuse Removal in Paris.

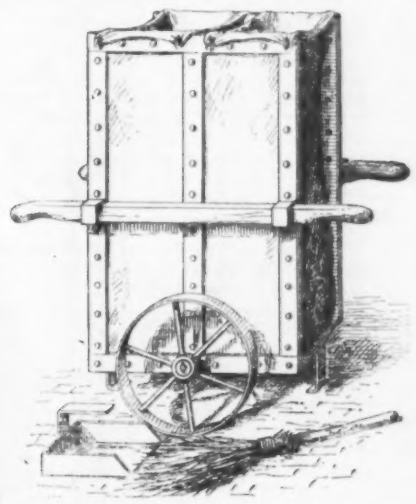
Many of our readers have probably noticed, on some of the streets of New York, Brooklyn, and Philadelphia, a staff of men or boys provided with bags and brushes for the immediate removal of refuse from the surface of certain streets. The bags used are shaped like the old-fashioned carpet-bag, and one of the lips is provided with a metal edge over which the refuse is swept by a brush. These bags when filled are emptied into proper receptacles, usually a cast-iron box, and these boxes are emptied by carts at stated periods.

The sketch here given shows a system for some time in use in Paris for a similar purpose. The bag-holder is a light wrought-iron vehicle, built as shown, and proportioned to carry two full bags in side, and two more on the outside hooks, if occasion should demand it. The street refuse is gathered in a pan of the form shown in the sketch, and similar to the London street pan. The Paris brush is usually made of a bundle of birch twigs.

The advantage claimed for this system is that the bags once filled on the street can be easily stored, then removed with a minimum of handling and scattered dirt. In London, the boys carry their pans, with their more or less offensive contents, to sidewalks and empty them into cast-iron boxes, which must be in turn emptied into carts by the shovel. The New York system saves running with every pan-full and covers up the refuse; but the emptying process is always troublesome, and can hardly be conducted without considerable dirt, in emptying the bags and the receptacles. The Paris system fills the bags at once; allows them to be stored, without offence or dirt, almost anywhere; and the final removal is expeditious and cleanly.

The Antiquity of the Use of Asphalt or Bitumen.

In a late notice of the works of the "Compagnie Générale des Asphaltes de France," *Le Génie Civil* quotes from a memoir published by the company some interesting data bearing upon the antiquity of the use of asphalt and bitumen.



The Paris Plan for Gathering Street Rufuse.

Its history practically goes back to the deluge, as the Book of Genesis speaks of bitumen as being used in constructing Noah's Ark; and it was also used by the old Hebrews in the walls of the Tower of Babel. The chief source of bitumen in those days was the Dead Sea, where it floated on the surface after issuing from numerous bituminous deposits on the bottom of the sea.

DIDEROT, in his *Encyclopædic*, ascribes the burning of Sodom and Gomorrah to the accidental ignition of petroleum or bitumen; and besides the Hebrews, the ancient Assyrians, Arabs, and Egyptians all utilized this fatty and inflammable material. The mummies of the Egyptians have been preserved to the present time by bitumen introduced between the bandages; but its more general and important use was as a cement in the walls of buildings. HERODOTUS, DIODORUS, SICULUS, and STRABO all mention the use of asphalt.

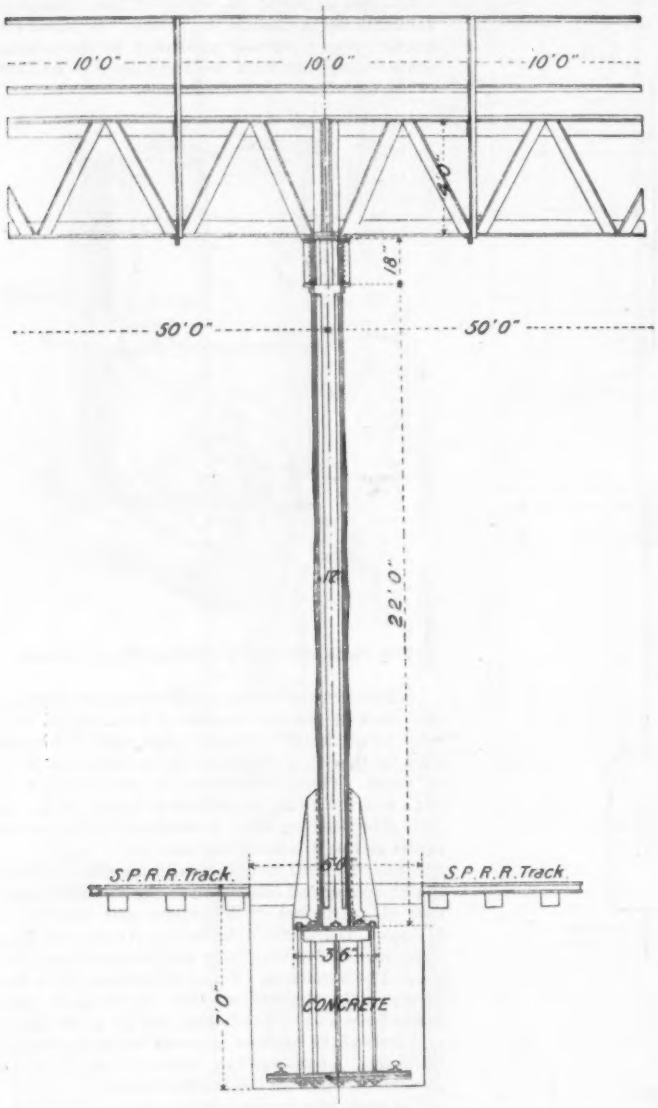
The walls of Nineveh were cemented with asphaltic mortar; and it was used with the bricks of Babylon as a substitute for the simple liquid clay of earlier times, says DIODORUS. The interior and exterior of the upper stories of Egyptian houses were coated with asphalt, as found in the ruins of Memphis and Thebes by MARIETTE Bey. The Egyptians also used it extensively in cistern construction, and asphalt is found as a cement in the base of the Pyramids.

The Phœnicians, and after them the Arabs, used bitumen in caulking their ships: and the Indians of the Island of Trinidad did the same with their canoes. The Romans employed it in the construction of their public and private baths and in building their *thermæ*.

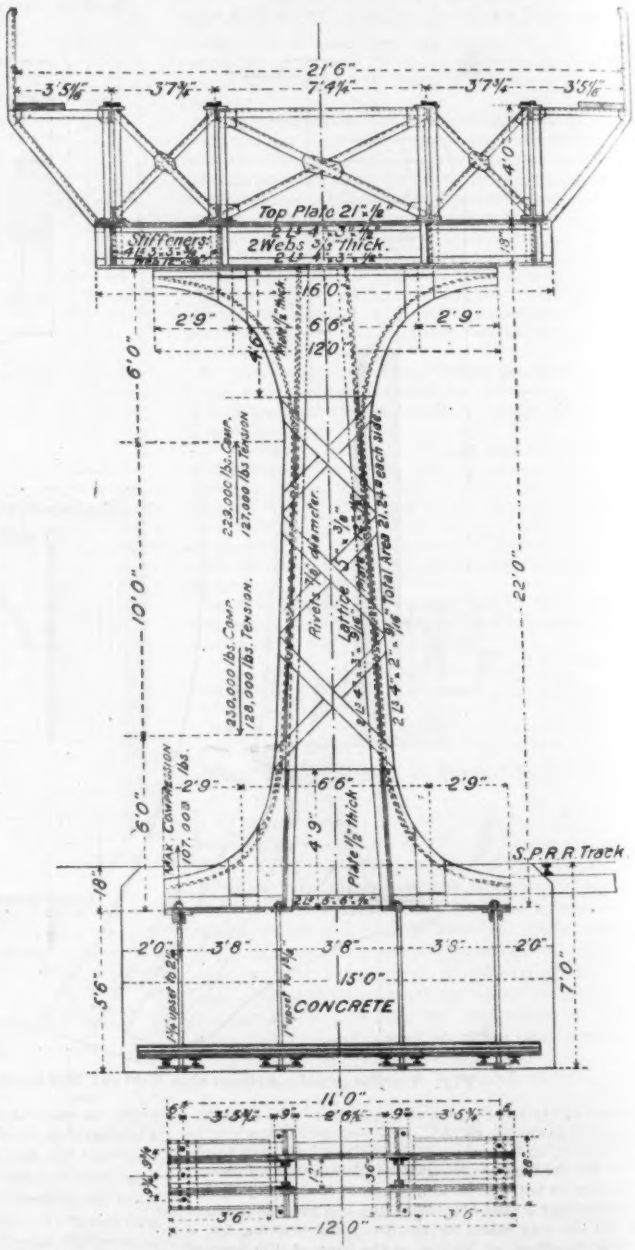
In Europe the use of asphalt dates from the commencement of the eighteenth century, and the first mine of asphalt was discovered at Neufchatel, in Switzerland, in 1710. This discovery was made by EIRINI d'EIRINYS, a Greek physician who published a short memoir on the subject at Paris in 1721 under the title of *Dissertations sur l'asphalte ou ciment naturel, découvert depuis plusieurs années au Val-de-Travers, dans le comte de Neufchatel, par le sieur Eirini d'Eirinys, professeur grec et docteur en médecine, avec la manière de l'employer tant sur la pierre que sur le bois, et les utilités de l'huile que l'on en tire.*

Viaduct for Cable Railway, Los Angeles, Cal.

The Los Angeles Cable Railway Co. has built an elevated road on San Fernando St., Los Angeles, Cal., which presents some unusual features in this class of work. The structure is 1,435 ft. long and is parallel to and over the tracks of the Southern Pacific Railroad. An agreement between the two companies provides that one column of limited dimensions shall carry the two tracks of the cable road. The accompanying cuts show the plan and elevations of this column. The top and bottom are spread to a width of 12 ft. and the base is embedded in and anchored to a mass of concrete 15 ft. long, 6 ft. wide, and 7 ft. deep to insure stability. On top of the column is fixed a cross girder 16 ft. long, on top of which the 50 ft. longitudinal spans are placed.



Side Elevation of Structure.



Cross Sectional Elevation of Structure and Sectional Plan of Base of Column.

Cable-Railway Viaduct, Los Angeles, Cal. SAMUEL G. ARTINGSTALL, C. E., *Engineer.*

The tracks are directly on the top flange of these girders, with the cable and carrying pulleys below. The structure was opened for traffic Nov. 2, 1889, and has proved to be very firm and free from vibrations, with trains at 5 minute intervals running at a speed of 12 miles per hour. The structure is designed for a moving load of 1,000 lbs. per lin. ft. of track and a wind pressure of 20 lbs. per sq. ft. of surface exposed, assumed, so far as column is affected, to be concentrated at track level. The total weight of the structure is 518 tons, or 722 lbs. per lin. ft. The work was built by A. Gottlieb & Co., Chicago. Mr. SAMUEL G. ARTINGSTALL, of Chicago, was the engineer.

The Effect of Fire on Iron Columns.

In a recent number of *Dingler's Journal* is an account of some experiments by Mr. BAUSCHINGER, of Munich, and Mr. MÖLLER, of Hamburg, on the effect of fire upon iron columns. The following conclusions are to be drawn from the experiments:

Cast-iron columns, highly heated, will not crack when water is played over them from a hose. It is to be noted that this statement is somewhat contradicted in another part of the article, where we learn that several columns did crack, during the trials, as indeed may be judged from experience on this side of the water.

Cast-iron pillars are still of considerable strength after a few cracks appear. In order to increase their strength after partial fracture through overheating has occurred, gas piping should be fixed inside the column. This pipe remains comparatively cool, and will tend to keep the pillar serviceable much longer than it otherwise would be.

The load upon the cast-iron supports should not be great enough to cause tension in any part of the column when it is highly heated on one side and a stream of water is being played upon the opposite portion.

The columns should not be too slender. The author recommends the length to be less than 10 diameters for pin ends, or less than 17 for fixed ends.

By covering the columns with a layer of mortar or some similar substance, the uneven heating of the column is prevented.

The experiments were not very many, but were carefully conducted, and are valuable as furnishing the only exact data of the action of fire on structural iron.

CORRECTION.—Prof. J. B. DAVIS's article on Traverse Surveying, referred to in our issue of Dec. 7, as read before the Illinois Engineering Society in 1883, was read before the Michigan Engineering Society in 1883, when the first-named society was not in existence.

PERSONAL.

Mr. D. M. PHILBIN has been appointed Superintendent of the Duluth, South Shore & Atlantic.

Mr. HERMAN B. WILSON, Superintendent of the Eighth Ave. R. R. Co., New York, died Jan. 16.

Capt. JAMES WORTHINGION, Superintendent of the Trenton Iron Works, died Jan. 9.

Judge SIDNEY T. HOLMES died at Bay City, Mich last week. He was at one time engaged in engineering work, but left it for the law.

Mr. R. G. BROWN, Auditor of the Milwaukee & St. Paul, died suddenly at Minneapolis, Minn., on Jan. 10.

Mr. H. J. PAYNE has been appointed Chief Engineer of the Duluth, South Shore & Atlantic Ry., and Mr. C. H. V. CAVIS has been appointed Consulting Engineer.

Mr. A. J. MANDERSON succeeds W. H. BURNS as Division Superintendent of the Union Pacific, with headquarters at North Platte, Neb.

Mr. J. LANSING MOORE, for several years Superintendent of the Silver Lake Railway, has resigned, and will probably be succeeded by Mr. H. T. GOULD, Assistant Superintendent.

Mr. C. F. LOWETH, M. Am. Soc. C. E., of St. Paul, Minn., who made the plans for Sioux City's sewerage system, has been appointed Chief Engineer of the Sioux City elevated railway construction, to act for the Rapid Transit Co.

Mr. W. F. KEARNEY has been appointed General Master Mechanic of the Ohio, Indiana & Western, vice Mr. J. KING, resigned. Mr. KEARNEY was for some years Division Master Mechanic on the Chicago, Burlington & Quincy.

Superintendent D. E. THOMPSON, of the northern division of the Burlington & Missouri, has resigned, and will probably be succeeded by Mr. BIGNALL, who is now the Assistant Superintendent.

Mr. JAY WESTINGHOUSE, President of the Westinghouse Co., of Schenectady, N. Y., manufacturers of agricultural implements, and eldest brother of Mr. GEORGE WESTINGHOUSE, died Jan. 17.

Mr. JAMES H. FLANNIGAN, of Oneida, N. Y., has been appointed Assistant State Superintendent of Public Works, for the middle division of the Erie Canal, vice Mr. JOHN STEBBINS resigned.

Mr. GEO. E. SIMMONS, of Cohoes, N. Y., has been appointed Assistant State Superintendent of Public Works, for the eastern division of the canals, vice Mr. CHAS. ZEILLEY, resigned.

Mr. WM. FLEMING died at Fort Wayne, Ind., recently. He was one of the originators of the Nickel Plate line (New York, Chicago & St. Louis R. R.) and was a director until the property was sold to the VANDERBILTS.

MARTIN J. BROWNE, a New Yorker by birth, a graduate of the Civil Engineering School of the University of New York, and for the past fifteen years engaged as an engineer in the Bureau of Sewers, is, we believe, the present most eligible candidate for the office of Engineer-in-Charge of Sewers, made vacant by the appointment of Mr. LOOMIS to the Street Cleaning Department.

Mr. GEO. L. HOGAN, formerly with the Scovil & Irwin Construction Co., and Mr. J. F. FALCONNET, engineer on the Nashville, Chattanooga & St. Louis R. R., have formed a copartnership as civil and mechanical engineers, and have opened offices at Nashville and Chattanooga, Tenn.

Mr. HENRY W. EWERS, of Manlius, N. Y., died last week. With his father, ELIHU EWERS, he was engaged at an early day in the construction of various public works in this and other States, among which were sections of the Erie Canal near Lockport and Lyons, also canals in New Jersey and some of the Southern States. The last public enterprise of this kind, in the construction of whose work he participated, was the New York & Erie Railway, where the Messrs. EWERS had a contract in Broome and adjoining counties.

Mr. ALONZO R. KETCHUM, of Buffalo, N. Y., Consulting Engineer for the water-works, died Jan. 12. He went to Buffalo in 1850, and under the contracting firm of Batton, Duncan & Co., assisted in the construction of the water-works at Black Rock. After the completion of this work he became the water-works' first superintendent, a position which he held until about ten years ago, after which he went into the contracting engineering business for himself. Among other work he erected water-works plants on Long Island, at Rochester, at Galveston, Tex., and at Memphis, Tenn. Coming back to Buffalo, about seven years ago, he built, and immediately afterward assumed control of the Fillmore Ave. foundry. Later he held a position under the Water Commissioners, and about three years ago he became Consulting Engineer.

Mr. HORACE LOOMIS, the lately appointed Commissioner of Street Cleaning in New York, was born in Binghamton, N. Y., about fifty years ago. He was graduated from the Rensselaer Polytechnic Institute at Troy in 1865, and was first engaged in railway engineering on the Lehigh Valley road. Subsequently he was interested in the Dutchess & Columbia R. R., the Hoboken and Fort Lee branch of the Erie R. R., in building the Erie docks and stockyards in New Jersey, etc. In 1875 he entered the service of the City as assistant engineer on the Croton Aqueduct, and made the first surveys for the new Croton Aqueduct. In March, 1886, he was made Chief Engineer of the Bureau of Sewers in the Department of Public Works of New York, and most acceptably filled that office until appointed to the higher one first mentioned. He has been a Member of the Am. Soc. C. E. since Nov. 5, 1879.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The names of the new committees appointed were given incorrectly last week. They were as follows: To report a series of Standard Sections for Railroad Rails—Messrs. H. STANLEY GOODWIN, A. M. WELLINGTON, SAM'L REA, THOMAS RODD, GEO. S. MORRISON, S. M. FELTON, Jr., D. J. WHITTEMORE, J. D. HAWKS, R. W. HUNT, J. FOSTER CROWELL, F. M. WILDER, E. D. T. MYERS, and L. G. F. BOUSCAREN. On Tests of Structural Materials.—L. G. F. BOUSCAREN, W. H. BURR, J. G. DAGRON, R. W. HUNT, H. G. MORSE, PERCIVAL ROBERTS, and H. B. SEAMAN.

On motion of Mr. DON J. WHITTEMORE, who objected to the Society, or a committee thereof, formulating anything in the way of a standard system of disposing material, the question of continuing the newly appointed rail-section committee in existence is to be referred to letter ballot.

Engineers' Club of Philadelphia.—Record of twelfth annual meeting, Jan. 11, 1890. President WM. SELLERS in the chair; 51 members and 1 visitor present. The retiring president, Mr. WM. SELLERS, delivered the annual address, which was devoted to the proper limitations of manual training schools and the character of instruction which should be given therein; also to the conditions necessary for permanently good highways and the practicability of attaining them, with a form of procedure that would accomplish the result without taxing the municipality.

The secretary and treasurer presented his annual report, showing the club to be in good financial condition. The membership embraced 2 honorary, 481 active, and 16 associate members. We had lost four active members by death during the year:—CHAS. A. ASHBURNER, SAM'L J. CRESWELL, CONWAY M. DAY, and EMIL FORDER. On motion of the secretary and treasurer, his accounts for the year were referred to the Finance Committee of the incoming board for audit.

The Tellers of Election reported that 254 votes had been cast, and that the following had been elected officers for 1890. President, Prof. H. W. SPANGLER. Vice-President, WILFRED LEWIS, Secretary and Treasurer, HOWARD MURPHY. Directors: JOHN T. BOYD, GEORGE BURNHAM, Jr., E. V. D'INVILLIERS, HENRY G. MORRIS, S. M. PREVOST.

The secretary presented, for Prof. L. M. HAUPT, Secretary of the Committee on Better Roads, of the University of Pennsylvania, the conditions of competition for the prizes of $400, $200, and $100 for the three best papers on road-making and maintenance. A full descriptive circular can be had on application by mail to Prof. L. M. HAUPT, at the University of Pennsylvania, Philadelphia.

Prof. H. W. SPANGLER then took the chair for 1890. He expressed earnest wishes for the welfare of the club, and particularly urged that we should all endeavor to harmoniously assist each other in promoting its interests and prosperity.

HOWARD MURPHY,
Secretary and Treasurer.

Boston Society of Civil Engineers.—The regular monthly meeting was held, Jan. 15, at the American House. President DESMOND FITZGERALD in the chair; 38 members and 8 visitors present.

The new Constitution and By-Laws reported at the last meeting were adopted.

Prof. THOMAS M. DROWN of the Institute of Technology read the paper of the evening entitled "Filtration of Natural Waters." The paper was discussed by Dr. S. W. ABBOTT of the State Board of Health and by Messrs. FITZGERALD, SMITH and WATSON of the Society.

S. E. TINKHAM, *Secretary.*

Civil Engineers' Club of Cleveland, O.—At the regular monthly meeting on Jan. 14, Mr. A. MORDECAI presented a paper on "The Harbor Facilities of Cleveland, especially for Handling Coal and Ore," in which he compared these facilities with those of other competing ports on the Lake. He began by saying that he proposed to show how Cleveland is falling off in the handling of coal and ore, as compared with other smaller ports on the lakes. The capacity of the railways is not merely what they can handle, but what they can get rid of. The railways should begin to wake up, as a project is now on foot to build a ship canal from Erie, Pa., to Pittsburg. This canal will strike the Shenango River, and thence by the Ohio to Pittsburg. This would take a great deal of trade away from other lake ports, and supply a large number of furnaces which are located in the valleys that the proposed canal will traverse. If vessels of heavy tonnage cannot pass through the canal on account of the shallowness of the water, lighters will undoubtedly be used. The furnacemen will build docks, and the vessels will have convenient places at which to unload. He spoke of the Cleveland breakwater and the dockage facilities of this port, and said that Ashtabula and Fairport were taking trade away from the city. The reason for this, in his opinion, is that they have better facilities for handling vessels.

Mr. EDWARD LINDSLEY exhibited a model of a machine for unloading coal cars by inverting them and thus avoiding as much as possible the breakage of coal. This was followed by a paper by Mr. J. H SARGENT, entitled "A Belt Line Railway and the Improvements of the Lake Front." He stated that for centuries the waters of Lake Erie have been wearing away the land and clay of the banks of Cleveland Bay, until now along the shore there is a shoal, and you have to go out about a quarter of a mile before you find 15 ft. of water. This shoal is just the space required, and is in the right place to accommodate the trade of all the great thoroughfares which enter Cleveland. This space should be docked and filled progressively in say blocks of 15 acres. This would give more than ½ mile of dock front, with 18 ft. of water or more. By this action at least 200 acres of land could be recovered. When this is accomplished a loop-line railway should be built by a combination of all the roads interested, that all may have joint use of it. Mr. SARGENT estimated that the cost of filling in each block of 15 acres would be from $75,000 to $100,000. He claimed that the loop-line railway would occupy 100 ft. in width of the reclaimed land at the shore and would share the expense.

O. O. PALMER, *Secretary.*

Western Railway Club.—At the meeting on Jan. 21 a paper was read by Mr. CREAMER on Car Ventilation. The following is a brief abstract:

Ventilation, correctly and scientifically speaking, is a change of air in the place to be ventilated, without violent drafts or chilling currents.

The requirements of car ventilation vary greatly. Limit a car to five or six occupants, and the ventilation is not much of a problem. Crowd into it thirty to fifty people, and the conditions are vastly changed. Car conductors have told me that they have often gone out on the platform in the middle of the night to get their lungs full of fresh air, to avoid being sick. I have seen passengers do the same.

Let us consider then the problem. A railroad car is a thing of motion. Why not use this movement to accomplish our purpose of ventilation, which, in our view, in this case, is a mechanical process purely. One of the radical improvements in car construction which is now coming to the front, and which, I think, in less than twenty years will be universal, is the vestibuling of cars. You all recollect when the monitor roof came into use thirty years ago. This form of car construction is now universal. Just so it will be in the near future with the vestibule system. In the present construction of cars one method of getting fresh air in is to take it from the platform through transom panels at the ends of the car. This has never seemed to me a very good plan for the reason that when the panel is open the inlet of air is too violent, especially to those sitting near the ends of the car. As a result of this the panel is apt to be closed all the time. The vestibuling of cars will necessarily do away with this method of inlet, poor as it is. You must get fresh air in by some other means than this and you must do it without cold drafts; any method involving, or in any degree liable to, drafts is sure to fail. We want the passenger to sit in the car whirling along at 40 miles an hour in just as much comfort as in his own easy-chair at home. He must not feel a suspicion of a cold draft, or the sense of smoke, or gas, or cinders, from the engine. We must establish and maintain a standard temperature, regardless of outside conditions. Seventy or seventy-two degrees is now pretty generally recognized as the proper temperature and satisfactory to the vast majority of people. To insure thorough diffusion and circulation, the points of inlet and outlet should be as far apart as possible.

I think the proper place, for the inlet is in the sides of the car body, about on a line with the windows, and not on the roof, where the smoke, cinders and coal gas follow along the sides of the clerestory, and often come in, especially in tunnels, cuttings and on side hills. Our moving car at 40 miles an hour will take in the fresh air at the rate of nearly 1,000 cu. ft a minute. We shall trap the cinders, and drive them out nearly as fast as they come in. This small whirlwind of fresh air we will warm by contact with the heating apparatus, whatever that may be, and then distribute it all around the car—not in one place, but in thirty or forty. Each passenger may have his own register and control it as he desires.

In summer we would cool this air, when the mercury is drifting about the nineties. In fact, I think it quite within the possibilities to make the moving railway car the most pleasant place possible in summer as well as in winter; so that the passenger can leave his car as clean at the end of his journey as when he began it.

The exit for vitiated air must be, I think, on the sides of the clerestory, with apertures three or four feet apart. These apertures must not admit air or cinders, smoke or rain. They must have the function of exhaust at all times, whether the car is stationary or moving. It seems to me the very height of absurdity that these outlets in the clerestory should be (as in many cars they are) so constructed that they must be changed by attendants with every change of the train. The train moving will do this very much better by its own motion. The cubical area of a car is so limited that power ventilation is an absolute necessity. The rules of ventilation applicable to a house or room, fail entirely in a crowded car.

I have spoken thus far of a car in motion. Cars filled with passengers are, however, often stationary and at times for prolonged periods. For such conditions I know of nothing better than open doors or windows. Our power ventilation then stops and we must resort to the same methods we would use in a house.

To accomplish successfully the results we aim at, the methods must be simple and within easy reach.

The men who go with trains—conductors, porters and brakemen—are not engineers. Whatever methods are used must come within easy grasp of their brains. To this subject an old and well-known mechanical axiom applies with force,—"The chief end of mechanism is to accomplish the desired results by the simplest method.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

VOL. XXIII. Saturday, Jan. 25, 1890.

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Coming Technical Meetings.

Engineers' Club of Philadelphia, Pa.—Next meeting Feb. 1. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of St. Louis, Mo.—Next meeting, Feb. 1. "Fuel Gas," W. B. Potter. Secy., W. H. Bryan, 809 So. 7th St.

Engineers' Club of Kansas City, Mo.—Next meeting, Feb. 3. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, Feb. 3. Secy., Geo. L. Wilson.

American Society of Civil Engineers, New York.—Next meeting, Feb. 5. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting Feb. 5. Secy., J. W. Weston, 710 La Salle St.

Civil Engineering Society (Mass. Inst. of Technology,) Boston, Mass.—Next meeting Feb. 6. Secy., Clement, March.

Association of Civil Engineers, Dallas, Tex. Next meeting, Feb. 7. Secy., E. K. Smoot, Elm and Austin Sts.

Civil Engineers' Club, Cleveland, O.—Next meeting, Feb 11. Secy., C. O. Palmer, 21 Cedar Ave.

New England Railroad Club, Boston, Mass.—Next meeting, Feb. 12. Rooms in the United States Hotel.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting Feb. 12. Secy. J. C. Herring, Wichita.

Western Railway Club, Chicago, Ill.—Next meeting, Feb. 18. Rooms in the Phœnix Building. Secy., W. D. Cross man.

Engineers' Society of Western Pennsylvania.—Next meeting, Feb. 18. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Feb 18. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, Feb. 20. Rooms at 113 Liberty St.

THE famous Strong locomotive No. 1, the "A. G. Darwin," has early in its life been a destroying agent. In a disaster near Cincinnati last week, its great weight and power undoubtedly helped to aggravate what might have been one of the most destructive accidents on record, except that the train into which it ran happened to have unusually few passengers. The cause of the accident was simply an abuse of the block system, which we cannot better describe than to quote from a local journal, with italics of our own.

The C., H. & D. has the block system along its entire route. The stations concerned in this disaster were Carthage and Winton Place. The accommodation train left Carthage for Winton Place, and Operator BRUNSON, of the former place, at once fixed the red signal.

He heard the following vestibule express coming, and at once called up Winton Place and asked if the accommodation had passed. The operator answered back that it had not, and that the block was still on. BRUNSON *calculated that the express could not overtake the accommodation*, as the latter must be about to leave Winton Place. *So he took the red slip from the block light, making it announce to the engineer of the coming express that the track was clear.*

Then he took up his green lantern, and walked out of the station, trying to light it. The green lantern is used in the freight service in connection with the block system. When the block signal is white and the station agent swings a green lantern, the engineer of the coming train knows that the block is only partially raised, and that he can come ahead, only he must come slowly. *This use of the green lantern is of great service in hurrying freight trains*, but the company does not allow it used in hurrying passenger trains on account of the element of risk—an element of great importance, as was shown last night.

Operator BRUNSON walked out, lighting his green lantern. The great Strong engine, with its enormous speed, came thundering on. *Then* BRUNSON *discovered that there was no oil in his lantern, and while he was tinkering with it, the express thundered by.* The engineer saw the white light, and supposing that all was well, opened the throttle and the train began to sweep around the curve of Chester Park. The curve was turned, the engineer glanced along the track, saw the red block signal at Winton Place, and touched the lever to slacken speed. Then he saw the red lights on the rear coach of the accommodation train, which was just leaving the Winton Place station.

Further comment than the italics of some of the sentences above is hardly needed. A "block system" operated in this way, which depends for its safety on the quickness with which the operator—in this case a boy of eighteen—can light a green lantern *after* displaying a white safety signal, might more appropriately be called a block-head system. We have not the rules of the company at hand to show to what extent they were infringed by the operator; but in all such cases we cannot feel that this matters much. A system which does not adequately consider and provide for the inevitable tendency of employés to stupidity and forgetfulness is not a proper one in fact, however well it may look on paper.

FORTUNATELY, there were only some thirty passengers on the accommodation train with which the "A. G. Darwin" collided, of whom only five were in the two rear cars. All of the latter were killed or burned alive. The accommodation train consisted of five cars, all of which are usually well filled, but this night was an exception. At the time of collision the train was by no means going at full speed; probably at about thirty miles per hour. The two rear cars immediately telescoped, the locomotive burying itself in them, but not to its own serious injury. Almost immediately flames burst out, as is claimed by Supt. NEILSON (on the ground that the car stoves remained upright), from the lamps; but as seems far more probable from the circumstances, from the ordinary car stoves with which the cars were provided. Not a wheel of either train left the track, and except that the cars at once took fire, only one or two deaths would have been likely to occur. The accident may therefore prove not wholly fruitless by reviving the flagging interest of the public and railway officials in car heating from the locomotive, the progress in which reform is by no means as rapid as it should be, although the last two years have undeniably seen great change for the better.

WE earnestly trust also that this occurrence, with the many less notable ones which occur weekly, will lead those mechanical officers who have been lending attention to proposals to light cars with gasoline in any form, to seriously consider the responsibility which they are thus assuming. We have expressed our views on this subject fully already, and do not care to go over old ground; but we feel no doubt that, bad as heating by cast-iron stoves is, it involves far less danger than would a general practice of lighting with gasoline in any form. On paper and in the laboratory such a system may be shown to be safe, as also can the transportation of dynamite. In practice, it will be inevitably and seriously dangerous, and most dangerous in grave disasters. To speak of only one phase of the question: Every serious collision involves telescoping; and telescoping involves one car going inside of another, *and* stripping off any roof projections inside the upper car. If these projections are filled with gasoline, what better conditions can be imagined for suddenly starting a fierce and disastrous fire?

IT is not impossible that the next great improvement in passenger rolling-stock will be some device for rendering telescoping impossible instead of merely difficult. The vestibuling of trains goes a long way toward realizing this device. Vestibuled cars have been in a number of collisions, but the first one has yet to be telescoped. The Blackstone coupler, formerly so much used on the Chicago & Alton, had this great merit, and it would seem not impossible to provide otherwise for so firmly interlocking the platforms of cars that the whole frame of a car should break up before one platform would mount the other. The introduction of the Miller platform vastly decreased this danger, which for our best-built cars is now comparatively small; but it still exists, and its existence does not seem necessary.

WHAT is "hardpan"? A correspondent propounds this conundrum to us in the following note, which it is extremely hard for us to answer:

> Will the NEWS please define the material commonly termed "hardpan"? There seems to be some difference among engineers as to its "make up" and price for handling same, and I believe your opinion would tend to establish a standard.

We hardly believe it possible for any merely human being to "establish a standard for hardpan," for the reason that its nature and composition vary materially in different localities, but we may venture an attempt at a definition, which will at least serve as a peg on which others may be hung.

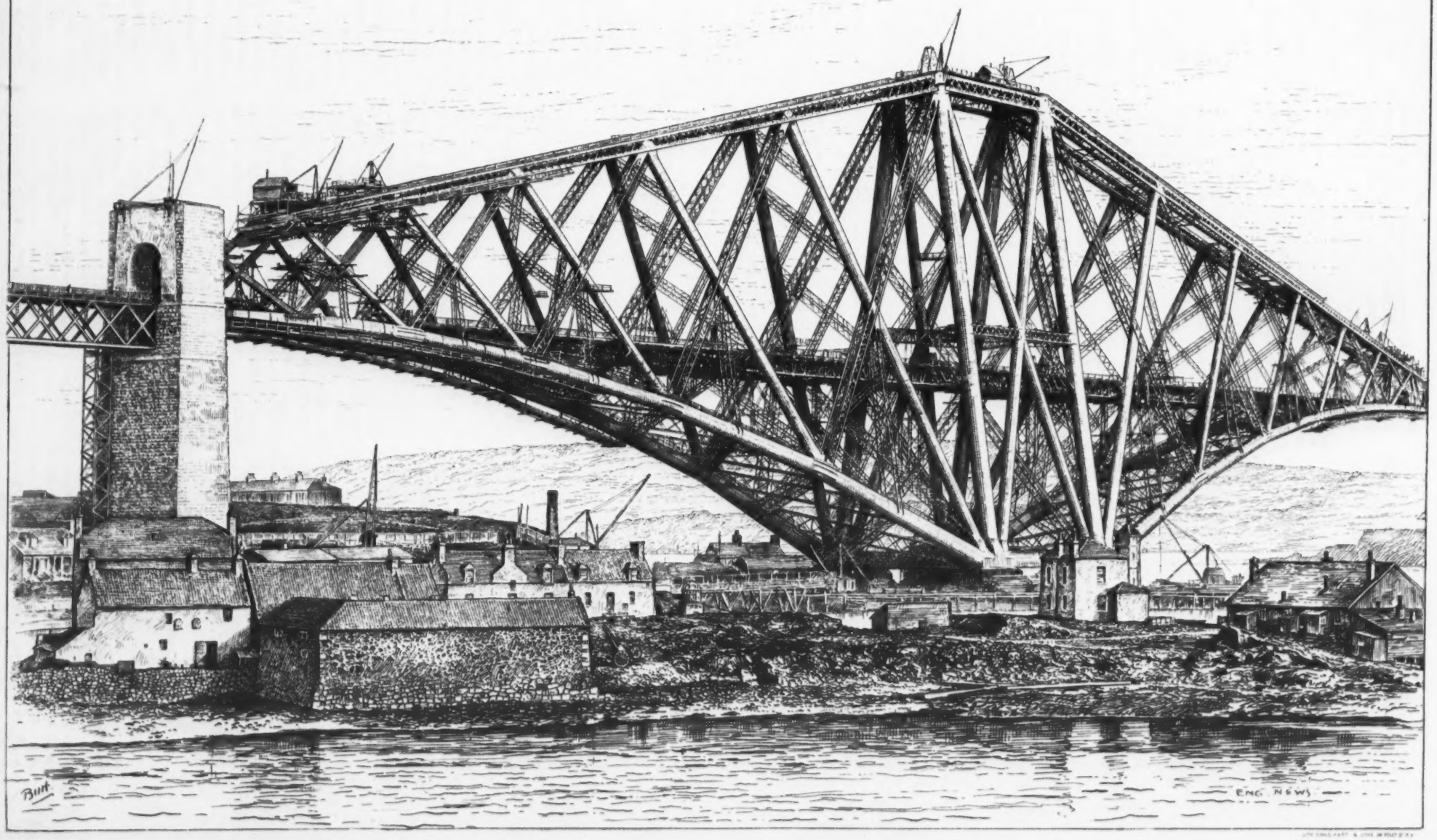
Hardpan is (always) a material softer than rock and yet harder than the hardest clay or earth. It (usually) can be effectively shaken up by powder, and (usually) contains many small stones and boulders, so cemented together that it is very hard to pick and almost (but not quite) impossible to plow, plowing being possible only with a heavy team, and to the depth of a few inches, and with a "rooting" plow, without moldboard.

This is as near as we can come to a definition, but as a matter of fact, according to our observation, it is but seldom attempted to measure hardpan accurately, but rather, if an earth cut is very hard, or a rock cut very soft, half or a quarter, or a third of it is called "hardpan," and the rest either earth or rock. In the hands of a conscientious and capable engineer, this mode of determining what is "hardpan" is sufficiently exact: otherwise it is apt to work injustice either to the company or the contractor.

THE FORTH BRIDGE.

VIEW OF FIFE PIER AND CANTILEVERS, FROM THE WEST.

SIR JOHN FOWLER AND BENJAMIN BAKER, ENGINEERS.



It seems probable that the Reading Terminal Railway, over which there has been so long a controversy between the Philadelphia & Reading Railroad Co. and the city authorities of Philadelphia, will now be put under construction. The Railroad Company is very desirous of making its new terminal at Twelfth and Market Streets, or as near as possible to the business center of the city. The ordinance which has passed the City Councils and has just received Mayor FITLER'S approval permits the company to build its tracks to a point within one block of the desired point, that is, to the north side of Arch St. Whether the company will accept this ordinance remains to be seen, but it seems probable that it will do so. Keeping the terminal one block further away from the business center will injure the residents of Philadelphia's suburbs who use the Reading Railroad more than any others. But it is probable that the effect will be transient, in any event, and that in a few years the growth of business on Arch St. and its vicinity will make the location of the Reading station fully as good as that of the Pennsylvania. Another feature of the ordinance which may cause its rejection by the company is, that it requires a four-track elevated road to be built to Glenwood Avenue, about three miles north of the Arch St. terminus. In the present condition of the Reading's finances, it is possible that some difficulty may be experienced in raising the capital necessary to build this expensive structure, except at exorbitant rates of interest. The Reading officials may well feel, too, that since far more benefit from this improvement will accrue to the residents and real estate owners of Philadelphia than to the Railway Company, the enterprise should receive hearty support, co-operation, and even financial aid from the city, instead of the grudging permission which has at last been given after three years of opposition and litigation.

We shall publish during the coming year, as a supplement to ENGINEERING NEWS, a complete index to it, from its modest beginning in 1872 to the present time, thus making any technical article which we have published instantly accessible, without the wearisome labor of hunting through volume after volume, perhaps on an unrewarded search for what is not to be found. This index will not, of course, include construction news, personal items, or small notes of merely passing interest, but all illustrations and all technical matter of permanent value will be duly referenced and cross-referenced.

It is our hope and present intention to issue supplementary indexes of the same kind at intervals of four or five years, and we need not say that these indexes constitute an additional reason why every engineer should bind his files, and thus obtain what in a few years will become in effect a technical library in itself. It involves some little trouble and expense to do this, and consequently many neglect it till it is too late, and nearly always to their regret. We mention the matter now because we have so lately begun a new volume.

It of course makes no difference to us what becomes of our papers after they have been paid for and mailed, and we mention the matter purely in our reader's interest, but there is no satisfactory way of preserving the information contained in technical journals other than by binding them. Many men at first conclude that they will simply "cut out what is valuable to them," but the trouble resulting from this plan is two-fold: The kind of matter which at the moment is supposed to be most likely to be useful in future often proves to be useless, while neglected subjects become the most important of all. Also the trouble of preserving and indexing such matter is considerable, and is rarely persevered in for any length of time. Binding the files complete, therefore, is the plan most truly economical of space, time, and money. We are pleased to learn that a complete index to the past Transactions of the American Society of Civil Engineers is about to be issued, similar to that which we have now in preparation for this journal. Such an index has been greatly needed, and has been too long delayed.

We postpone to a later issue the publication of some further letters relating to the allegation of Mr. R. C. BLACKALL, in our issue of Jan. 11, that "many of the most pronounced advocates of the M. C. B. type of car coupler were already weakening in their allegiance," becoming dismayed at constant breakages, and what not. Suffice it to say, for this issue, that we have not yet been able to discover that any one who has favored the M. C. B. type, or tried it on a large scale, holds these dismal views, while the overwhelming preponderance of evidence is that the change is generally regarded as a very satisfactory and promising one. Certainly, the introduction of automatic freight couplers and brakes is now progressing more rapidly than any radical change of mechanical practice has ever yet done; and as soon as the certain fact begins to dawn more clearly upon railway managing officers that enormous operating economics in the way of longer and yet faster freight trains are to result from the joint introduction of these betterments—economics in comparison with which any possible difference in mere maintenance charges sinks into insignificance—the rate of progress of the reform will again be greatly accelerated. The chances seem very strong that even A. D. 1900 will find "the more excellent way" of equipping and handling freight trains an accepted fact.

ENGLAND is apparently becoming convinced that it does not pay to build 110-ton guns at a cost of about $150,000 each. Of the seven 110-ton guns now in existence, four are pronounced dangerous, though they have never been subjected to one-half hour's continuous firing. The two big guns of the iron-clad *Benbow* were the last to fail, on Jan. 17, and this follows the discovery made, two months ago, that of the four 110-ton guns intended for the *Victoria*, one had drooped at the muzzle and another had developed a crack in the test. These guns are 16-in. Armstrong guns, firing an 1800-lb. projectile with an 850 to 900 lbs. powder charge, and are supposed to have a range of about fifteen miles. The trouble seems to lie in the inherent difficulties of manufacture and in the employment of a charge far surpassing that used in the Krupp 15¾ in. gun, which weighs 119 tons and fires a 2000-lb. projectile with 737 lbs. of powder. The resulting muzzle energy of these two great guns is 519 ft. tons for the Armstrong as compared with 385 ft. tons for the Krupp, a gain in energy that must be paid for in an increased strain on the gun. Aside from the cost and risk of manufacture, the question is now being asked whether it pays to build a gun at all that has an estimated lifetime of only 125 full-charge shots. The disintegration and erosion in guns of this calibre is said to be so rapid that they can be depended upon only for this number of service charges. In addition to this, they are unwieldy, and the time interval between firing is so great that a quick-moving enemy need be exposed to not more than two rounds. These are all points worth considering when the United States is considering the expenditure of nearly $300,000,000 in building and arming war-ships.

A correspondent asks:

Have you any knowledge of COL. LEONARD WRIGHT, a civil engineer, who, I am informed, was engaged up to a few years past on engineering work in New York City or vicinity? He formerly resided in Connecticut. He was engaged in the construction of the Allegheny Valley Railroad.

Some of our readers can doubtless give the desired information, if the above statements are correct, and they will kindly do so promptly, whether or not they can give Col. WRIGHT'S present whereabouts. We have counted up eighteen different WRIGHTS on our subscription list, tending to show that the WRIGHTS are an engineering family, but no LEONARD WRIGHT is among them.

In appointing Mr. LOOMIS, late Chief Engineer of Sewers, as the new Commissioner of Street Cleaning for New York, Mayor GRANT has probably disappointed some of his friends, but he has also most agreeably disappointed the general public. There was a lively suspicion abroad that, after being offered to capable men who were so situated that they could not accept it, the position would finally fall to the lot of some one whose political usefulness was his chief recommendation. But, on the contrary, the present commissioner is not a politician, in the improper sense of the word; but he is an engineer of long experience, of exceptionally good repute in his profession, thoroughly familiar with the methods of the New York departments; and by the very circumstances controlling his appointment, he should be much less trammelled in the performance of his duty by political affiliations or obligations than is the average head of a department. Mr. LOOMIS has no light task before him; but if he is to prove the "angel" that some of the papers of this city thought was necessary to fill the position, he must be left free to use his experience as an engineer and his executive ability as a man without thought of service as a politician. If Mayor GRANT will honestly sustain him in the position in which he has placed him at the start, as he seems disposed to do, the problem of clean streets can be solved; but the elimination of politics is the only condition upon which true success can be attained. Give Mr. LOOMIS the amount of the annual appropriations to clean the streets, and to clean the streets alone, and we are confident that his work will go far toward lifting from this metropolis one of its sources of reproach. The experiment is well worth trying.

Metal Interests in 1889.

The *Engineering and Mining Journal* of Jan. 4, 1890, contains a most creditably complete summary of mining interests during the past year, the difficulties in compiling which, with such promptness as to publish them immediately after the close of the year, must have been very great. In large part the statistics are of prices, fluctuations of market, stock in hand, exports and imports, prices of mining stocks, etc., etc., which for the most part (especially the last we hope) would have no special interest for our readers, but certain of the statistics are of the greatest use to every intelligent man, showing as they do a most amazing growth, as well as some significant changes which are silently but rapidly going on.

This is especially true of the copper interest, which is also the most fully shown of all. It seems almost incredible

that such astounding changes can have taken place within a decade as are actually shown in the accompanying table, which we abstract and condense from several of those given, adding a table of percentages from which the tendency of the statistics can be at once detected. The copper production of the United States has nearly quadrupled in ten years, that of the world has nearly doubled. The United States product has increased from 20 per cent. of the world's production in 1881 to 41 per cent. in 1888, and probably a good 50 per cent. in 1890, if recent tendencies hold good for twelve months more. Europe has fallen off slightly in percentage, South America enormously (from 27 to 12 per cent.), and the rest of the world is nearly constant at 12 per cent.

The most amazing growth in the United States is shown by Montana, a new-born State which in 1881 did not produce enough copper to be separately listed, but which now has far outstripped the Lake Superior region, and produces over 40 per cent. of the total product of the United States, and far more than the total copper production of the United States so recently as 1882.

The United States exports of copper, which were about one-fourth of the whole product in 1885, and about one-seventh in 1887, were only 6.2 per cent. of the whole in 1888, or somewhat over 15 million pounds. The present stock of copper in the United States is about 65 million pounds.

The price of copper has fallen since 1860 in the notable manner shown below. We convert the London prices in pounds sterling per long ton into cents per pound, for comparative purposes. The effect of the short-lived copper syndicate is notably visible in 1888, but there is no reason to believe that the permanent price of copper will be even as high as it was before that syndicate began operations.

COPPER PRODUCTION OF THE WORLD, 1881-1889, IN MILLIONS OF POUNDS.

	1881	1882	1883	1884	1885	1886	1887	1888	1889
Lake Superior	54.55	57.16	59 70	69.35	72.15	79.89	75.47	86.58	86.14
Arizona	.....	.....	.....	26.73	22 71	16.00	17.79	32.52	31.60
Montana	.....	.....	.....	43.00	67.80	57.61	78.70	98.50	104.20
Other U. S	.....	33.49	55.83	5.78	3.22	3.24	8.96	22.40	....
Total U. S	73.5	90.65	115.53	144.95	165.88	156.74	180.92	240.00	.....
Europe	146.	150.	162.	168.	171.	168.5	182.	211.	....
So. America	99.5	115.	107.	108.	100.	90.	75.5	71.	.....
Other Countries	44.	48.35	63.47	64.05	67.12	64.76	65.58	66.	....
The World	363.	404.	448.	485.	504.	480.	504.	588.	.....
Per cent. of Total Product.									
United States	20.3	22.4	25.8	29.9	32.9	32.7	35.9	40.8	.....
Europe	40.2	37.1	36.2	34.7	33.9	35.2	36.1	35.9	....
So. America	27.4	28.5	23.9	22.3	19.8	18.7	14.9	12.1	....
Other	12.1	12.0	14.1	13.1	13.2	13.4	13.1	11.2	....
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.....

PRICE OF COPPER SINCE 1860.

Year.	Cents per lb. In U. S.	Cents per lb. London.	Year.	Cents per lb. In U. S.	Cents per lb. London.
1860	22¾	—	1875	22½	18.0
1861	19⅛	—	1876	21	16.7
1862	25⅜	—	1877	18⅝	15.3
1863	32⅞	—	1878	16½	13.7
1864	46¼	—	1879	17⅛	12.8
1865	36¾	—	1880	20⅛	13.8
1866	31⅜	18.0	1881	18⅛	13.3
1867	25⅛	15.6	1882	18¼	14.6
1868	23⅝	15.5	1883	15¾	13.8
1869	27⅝	15.2	1884	13⅝	11.7
1870	30⅝	14.3	1885	11⅛	9.59
1871	29⅝	14.8	1886	11	8.83
1872	33	20.2	1887	11¼	9.85
1873	29	18.6	1888	16¾	17.9
1874	23¼	17.0	1889	13¾	11.2

The price of lead has fallen, and the total production increased only less notably than that of copper, as the table will show. It is believed that the Montana lead production has only fairly begun, and that "this is undoubtedly the future home of the lead produc of this country." It will be seen that since 1881 our lead production has increased about 63 per cent., the imports since 1879 having remained small and constant at a few million pounds only. In 1873 we imported about 38,000 tons, making our total consumption at that time some 80,000 tons against 190,000 now.

PRODUCTION OF LEAD IN UNITED STATES, TONS OF 2,000 LBS.

Year	Colorado.	Idaho and Montana.	Mo., Kan., Ill., and Wis.	Utah.	Total production.	Price, cts. per lb.
1873	56	.....	22,381	15,000	42,540	6.32
1874	312	.....	.....	20,000	52,080	6.01
1875	818	.....	24,699	19,000	59,640	5.85
1876	667	.....	26,421	25,000	64,070	6.13
1877	897	.....	31,153	27,000	81,900	5.49
1878	6,300	.....	29,770	21,000	91,000	3.61
1879	23,674	.....	28,130	14,000	92,780	4.14
1880	35,674	.....	27,600	15,000	97,825	5.04
1881	40,547	.....	30,770	24,000	117,085	4.81
1882	55,000	.....	29,015	30,000	132,890	4.91
1883	70,557	11,000	21,600	29,000	143,957	4.32
1884	63,165	14,500	19,676	28,000	139,897	3.74
1885	.....	.....	.....	26,000	129,412	3.95
1886	59,100	17,000	22,000	24,000	135,629	4.63
1887	63,000	27,000	28,000	22,000	160,700	4.50
1888	65,442	34,875	30,000	22,283	186,000	4.42
1889	70,000	30,000	34,000	22,000	190,000	3.96

Tin has been nearly constant in price this year at 21.8 cts. per lb., against 36.2 cts. the year before, and 24.85 cts. in 1887. The permanent natural price seems to be now about 20 or 21 cts., the higher rates being due to combination.

Quicksilver is falling off in product and rising in price. The tendency of the product seems to be to remain nearly constant at 30,000 flasks or more (last year only 25,650). The price for the past three years has been $42 to $45 per flask, against $30 to $35 before.

In zinc the United States does not play a leading part, yet its product has increased 250 per cent. since 1880, or vastly more than any other country. The following table shows the figures in detail:

THE WORLD'S PRODUCTION OF ZINC, IN TONS OF 2,240 LBS.

	United States	Belgium	Silesia	Great Britain	Total
1880	20,749	98,830	64,450	*22,000	227,558
1881	30,000	110,989	66,497	24,419	258,533
1882	*30,148	119,193	68,811	25,581	271,302
1883	32,921	123,891	70,405	28,661	278,954
1884	34,414	130,522	76,116	29,259	294,286
1885	30,339	129,754	79,624	23,099	292,571
1886	38,072	129,039	81,630	20,730	292,662
1887	44,947	130,995	81,375	19,319	299,810
1888	49,922	133,245	83,375	26,633	316,927

France and Spain in this period increased from 15,000 to 16,140 tons; Poland decreased from 4,000 to 3,800; Austria increased from 2,520 to 3,830. These quantities are included in the total.

The price of zinc in cents per pound has fluctuated as follows, the decrease being relatively small:

1875 ..... 7.00	1880 ..... 5.51	1885 ..... 4.34⅛
1876 ..... 7.25	1881 ..... 5.24¼	1886 ..... 4.40
1877 ..... 6.06	1882 ..... 5.32½	1887 ..... 4.62½
1878 ..... 4.88	1883 ..... 4.49⅛	1888 ..... 4.91
1879 ..... 5.03¾	1884 ..... 4.44¼	1889 ..... 5.02¾

The statistics given as to gold and silver are also very complete. We abstract from them the following little table showing the production in 1885-88, to which we add computations of the per cent. of the American product, and also, from other sources, the average yearly rate of production in the three preceding decades. The table is a sermon on the silver question in itself, and shows clearly why the United States is peculiarly the home of what the gold-bugs derisively call the "silver craze," and also why said bugs are so successful in their machinations against that deserving and persecuted metal:

YEARLY PRODUCTION OF PRECIOUS METALS, 1885-1888.

Year.	World's Production		In Millions of Dollars, United States.		Percent. U. S	
	Gold	Silver	Gold	Silver	Gold	Silver
1885	108.4	118.5	31.8	51.6	29.4	43.5
1886	105.2	120.6	35.0	51.0	32.9	42.3
1887	107.0	125.6	33.0	53.4	30.8	42.5
1888	106 0	142.4	33.2	59.2	31.2	41.4
1851-60av.	137,0	39.3	55.1	0.1	36.1	0.1
1861-70 "	128.1	53.4	47.4	10.1	37.1	14.8
1871-80"	116.6	87.5	39.5	35.0	28.2	37.7

Silver valued at U. S. Coining rate, 15. 99 to 1.

When the production of a metal is increasing, the world over, in such rapid ratio as the second column of this table shows, while at the same time the production of another is steadily decreasing, it is obviously hopeless to keep the values of the two at the constant ratio. That these conditions are likely to continue is evident from the striking fact that silver is found in immense bonanza deposits, while most of the gold product is, and has been from the beginning of history, from scattered washings and pockets which are soon exhausted. How recent the great change in value is, and hence how natural it is that the silver issue should be a very live one, is strikingly shown in the following table of the value of silver since 1501, and for each year since 1687, which we extend from one given in the *Engineering and Mining Journal*. It will be seen that the extreme fluctuation in the silver ratio in the 186 years between 1687 and 1873 was only from 14.14 to 16.25 (15.63 at the end of the period) whereas since 1873 began, silver has fallen from 15.63 to 22.06, or 29¼ per cent.

The enormous fall of nearly 50 per cent. in the silver ratio between 1500 and 1680 was of course due to the lootings of CORTEZ and PIZARRO and the opening of the great mines of the New World, from which nearly seven-eighths (84.5 per cent.) of the world's product since 1500 has been derived. There was in 1500 hardly a twentieth part of the present stock of silver in the world, and its value was just about double what it is now. At present the increase is so rapid that, whereas it took 500 years to accumulate the world's stock of 7,228 million dollars' worth of silver (U. S. coin value) in 1880, the production in the eight following years was 969 millions, an increase of 13.4 per cent., making the stock at the end of 1888, 8,197 millions.

The Mexican silver product has been increasing recently much faster than that of the United States. The comparative figures are:

SILVER PRODUCT IN MILLIONS OF DOLLARS.

	1885	1888	*P. C. incr.*
Mexico	32.1	41.4	29.0
United States	51.6	59.2	14.7

The production of silver in sensible quantities did not begin in the United States till 1881, and it was 1871 before the annual rate struck 20 millions and 1881 before it reached 45 millions. Up to 1881 we had produced 462 millions, and since then have produced 400

RATIO OF SILVER TO GOLD SINCE 1501 AND FOR EACH YEAR SINCE 1687.

[NOTE.—From 1687 to 1832 the ratios are taken from Dr. A. SOETBEER; from 1833 to 1878 from Pixley & Abell's tables, and from 1878 to 1888 from daily cablegrams from London to the Bureau of the Mint.]

Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio.	Year.	Ratio.
1501 to 1560	11.1	1714	15.13	1750	14.55	1786	14.96	1822	15.80	1858	15.38
		1715	15 11	1751	14.39	1787	14 92	1823	15.84	1859	15.19
		1716	15.09	1752	14.54	1788	14.65	1824	15.82	1860	15.20
1561 to 1620	11.8	1717	15.13	1753	14.54	1789	14.75	1825	15.70	1861	15.50
		1718	15.11	1754	14.48	1790	15.04	1826	15.76	1862	15.35
		1719	15.09	1755	14 68	1791	15.05	1827	15.74	1863	15.37
1621 to 1680	14.5	1720	15.04	1756	14.94	1792	15.17	1828	15.78	1864	15.37
		1721	15.06	1757	14 87	1793	15.00	1829	15.78	1865	15.44
		1722	15.17	1758	14 85	1794	15.37	1830	15.82	1866	15.43
1687	14.94	1723	15.20	1759	14.15	1795	15 55	1831	15.72	1867	15.57
1688	14.94	1724	15.11	1760	14.14	1796	15.65	1832	15.73	1868	15.59
1689	15.02	1725	15.11	1761	14.54	1797	15.41	1833	15.93	1869	15.60
1690	15.02	1726	15.15	1762	15.27	1798	15.59	1834	15.73	1870	15.57
1691	14.98	1727	15.24	1763	14.99	1799	15.74	1835	15.80	1871	15 57
1692	14.92	1728	15.11	1764	14.70	1800	15.68	1836	15.72	1872	15.63
1693	14.83	1729	14.92	1765	14 83	1801	15.46	1837	15.84	1873	15.92
1694	14.87	1730	14.81	1766	14.80	1802	15.20	1838	15.85	1874	16-17
1695	15.02	1731	14.94	1767	14.85	1803	15.41	1839	15.62	1875	16.59
1696	15.00	1732	15.09	1768	14 80	1804	15.41	1840	15.62	1876	17.88
1697	15.20	1733	15.18	1769	14.72	1805	15.70	1841	15.70	1877	17.22
1698	15.07	1734	15.39	1770	14.62	1806	15.52	1842	15.87	1878	17.94
1699	14.94	1735	15.41	1771	14.66	1807	15.43	1843	15.93	1879	18.40
1700	14.81	1736	15.18	1772	14.52	1808	76.08	1844	15.85	1880	18.05
1701	15.07	1737	15.02	1773	14.62	1809	15.98	1845	15.92	1881	18.16
1702	15.52	1738	14.91	1774	14.62	1810	15.77	1846	15.90	1882	18.19
1703	15.17	1739	14.91	1775	14.72	1811	15.53	1847	15.80	1883	18.64
1704	15.22	1740	14.92	1776	14.55	1812	16.11	1848	15.85	1884	18.57
1705	15.11	1741	14.92	1777	14 64	1813	16.25	1849	15.78	1885	19.41
1706	15.27	1742	14 85	1778	14.68	1814	15.04	1850	15.70	1886	20.78
1707	15.44	1743	14.85	1779	14.80	1815	15.26	1851	15.46	1887	21.13
1708	15.41	1744	14.87	1780	14.72	1816	15.28	1852	15.59	1888	21.99
1709	15 31	1745	14 98	1781	14.78	1817	15.11	1853	15.33	1889	22.06
1710	15.22	1746	15.13	1782	14.42	1818	15.35	1854	15.33	1890	
1711	15.29	1747	15.26	1783	14.48	1819	15.33	1855	15.38		
1712	15.31	1748	15.11	1784	14.70	1820	15.62	1856	15.38		
1713	15.24	1749	14.80	1785	14.92	1821	15.96	1857	15.27		

millions. Mexico, on the contrary, has been producing silver since 1537, its average yearly rate for the 284 years up to 1821 having been 7.2 millions, and between 1821 and 1880, 14.2 millions. The present rate of increase is very notable, and in combination with United States experience tends to greatly discourage the hope that a serious and permanent drop in the comparative value of silver, comparable only with that which took place in 1500-1620, can be avoided. It will be seen that even the great gold product of 1849-60 in California and Australia did not seriously affect the value of silver, which shows how far-reaching must be the causes which have lately effected such great changes.

The following table shows last year's fluctuation of prices in the leading classes of iron, from which it will be seen that the price of pig iron, even Bessemer pig, has been nearly constant through the year, but that of steel rails has fluctuated enormously.

MONTHLY AVERAGE PRICES, NEW YORK MARKET.

Per ton of 2,240 lbs.	January.	February.	March.	April.	May.	June.	July.	August.	September	October.	November	December.	Average.	Variation.
Pig Iron:														
No. 1 Foundry	18 00	17.50	17.50	17.25	16.50	17.00	17.00	17.50	17.50	18.00	19.50	17.50	17.60	3.00
No. 2 Foundry	17.00	16.50	16.50	16.25	15.50	16.00	16 00	16.50	16.50	17.00	17.50	18.50	16.65	3.00
Forge	16.00	15.50	15.50	15.50	15.25	15.50	15.50	15.50	16.00	16.50	16.75	17.50	15.91	2.25
Bessemer	16 50	16.50	16.00	16.00	16.00	16.00	17.00	18.00	18.50	19.50	21.50	23.75	18.93	7 75
Scotch Pig:														
Coltness	20.50	20.50	20.50	20.50	21.00	21.50	21.75	22.00	23.00	25.00	26.50	27.00	22.48	6.50
Steel Rails	27.00	27.00	27.00	27.00	26.75	27.50	28.00	28.00	29.00	32.00	33.00	35.00	28.93	8.25
Old Iron Rails	23.00	23.50	23.00	23.00	23.00	22.50	23.00	23.00	23.50	24.50	25.50	27.00	23.70	4.50

In regard to the steel rail market for the past year, the *Engineering and Mining Journal* says:

The production of steel rails in 1889 was about 1,350,000 tons, or about as large as in 1888, though only about two-thirds as large as in 1887. Nevertheless the mills, which are acting together under a "Board of Control," were able to advance prices from $25.50 or $26 per ton in June, the lowest price for the year, to $35 a ton in December. Until June the market went from bad to worse, the general dullness occasioning cutting prices on all sides. Competition was naturally sharp, and many of the mills booked orders for forward deliveries at the low prices then ruling.

The consolidation of the North Chicago, Union and Joliet companies, which was consummated in May, was probably the most important event of the year, and by its competition in the Northwest was, to a great extent, removed. Without this consolidation it is very doubtful if the recorded advance in prices would have been possible. The increased consumption of other steel products naturally strengthened this market in the latter part of the year.

The anthracite coal production fell off a little from last year, yet comparing the past 38 years, the steady growth may show as follows:

MILLIONS OF GROSS TONS, ANTHRACITE COAL.

1850	1860	1870	1880	1885	1887	1889
3.4	8.5	16.2	28.4	31.6	34.6	35.5

The world's production of coal in 1888 (Sweden and Spain one year, and Italy two years behind) was as follows: We add 1860, 1880, and percentages for comparison:

THE WORLD'S PRODUCTION OF COAL.*

	1860	1880	1888
	Tons.		
Great Britain	85	147	170
United States	15	70	127
Germany and Luxemburg	14	59	82
France	8	19	23
Belgium	10	17	19
Austria and Hungary	3	16	21
Russia	1	7	5
Other countries	5	9	11
Total	141	344	458
Percentage of the United States	10.6	20.3	27.7
" " Great Britain	60.3	42.7	37.2

Of course, as commercial rivals of England, it is gratifying to see that we are steadily creeping up towards her; but the larger fact is that the English-speaking race as a whole handles over three-quarters of the total coal product of the world, and that this predominance, instead of decreasing, tends rather to increase.

That it is destined to increase for at least a century to come seems almost certain, but that the growth will be chiefly in this country seems as sure.

Engineering vs. the Philadelphia Department of Public Works.

The improved sewerage of Philadelphia is again interesting the Councils of that city, and the question is being discussed whether it is better to secure the services of an expert engineer, to report upon some comprehensive and acceptable plan; or to create a Bureau of Sewers in the present Department of Public Works, and leave the whole question to the engineer appointed as the head of that bureau. The latter recommendation, favored by the Director of Public Works, suggests some comment upon the status of engineers under the new charter now in force in Philadelphia.

Under the old city government, the Councils elected the heads of the departments, and the design, execution, and control of all public works were distributed among many independent chiefs. In April, 1887, a new city charter went into effect, and the chief executive power was vested in the Mayor. This official now appoints the heads of certain great departments, and among these is a Director of Public Works, who is put in control of all the engineering work of the city.

As far as this concentration of departments is concerned, the new charter is a decided improvement upon the former very much mixed condition of affairs. But the reformers, in framing the new law, made the common error of ignoring the engineer altogether, and of making him a mere subordinate of the Director, to be appointed and removed at the will of this official. The new law failed to specify any requirements for the head of the department, and it does not in any way define the duties, powers, or responsibility of the engineering assistants necessary for the proper and efficient conduct of the affairs of this important department of the city government.

Under the law, the engineering staff of Philadelphia has practically no defined position; their selection depends upon the whim or judgment of an official who can hardly be an engineer himself, under the rules usually governing municipal appointments of this kind, and the official head of the engineer depends not so much upon his fitness for office as upon his agreement with the more or less crude ideas of engineering methods held by his chief. The result of this system is that, unless the head of the department is a man of exceptionally sound judgment and common sense, the engineer loses all personality. He is reduced to the level of a clerk, and really good technical work is credited to his chief, who alone is known to the public; while in case of failure, for which the engineer may or may not be responsible, his office becomes that of a scapegoat for the non-technical head of his department.

Under these conditions, the engineering positions in the Philadelphia Department of Public Works were not calculated to invite or retain talent and experience of a high order, and if that city honestly wants a well digested and efficient system of sewers, it had better secure the services of an engineer outside of the immediate control of its City Government. The problem is a complicated one; and investigation of existing methods and suggestion of improvement require a higher class of talent than would be likely to seek permanent employment in the proposed Bureau of Sewers. The formulation of new plans will be in no wise assisted by being under the immediate control of a Director who knows nothing about the subject: but we can conceive how an inexperienced but autocratic officer might seriously interfere with the success of a well-meaning and experienced engineer who was absolutely in his power.

Although Philadelphia has the latest of new city charters, its working has not been eminently successful, if we may judge from what is said by the press of that city; and in its methods of managing public works it is a conspicuous example of misapplied reform. Its Department of Public Works was supposed to be modeled in part after that of New York; but while this city is by no means a

model, each of the various bureaus of the department here has its Chief Engineer, who is publicly recognized as such and held personally and professionally responsible for his work. The Chief Commissioner, or Director, in this case is the executive officer only, and his subordinates have very considerable power and personality, each in his bureau. The Philadelphia plan errs in practically assuming that any man put at the head of its Department of Public Works is by his position alone made the chief of all engineering work as well; that he is fully capable of selecting his engineers and of deciding all disputed points of engineering practice, and that the employment of engineers is a mere matter of form. In other words, the framers of the new law assumed that the duties of an engineer began and ended with "drawing lines and driving stakes," and consequently delegated his really important duties to some one who was not an engineer. This is a view of the case unfortunately too common; but it is also one that sooner or later leads a city into the execution of badly digested, extravagant, or utterly valueless schemes of public work, and the engineer's revenge comes with the result of the "economy" and lack of judgment that left him out of the municipal organizations.

CORRESPONDENCE.

What is the Feminine of "Draughtsman"?

VISALIA, Cal., Dec. 31, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Will you please inform me through the columns of your "journal" what the feminine of draughtsman is?

And oblige,

MISS EVA WARNER.

[As the term defines work done, and does not properly in itself apply to the sex of the worker, we would not suggest a feminine form therefor; unless we follow the fashion set by certain dry-goods establishments, and call the feminine worker "a draughtslady." We would not recommend this, however. "Draughtswoman" would be perfectly correct if there existed any valid reason for making a distinction as to sex.—ED. ENG. NEWS.]

The Palmer Car Starter.

PHILADELPHIA, Pa., Jan. 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: The article published in your issue of Jan. 11, descriptive of my improved horse-car starter, is quite explicit and satisfactory with the exception of the typographical error in the second line from the bottom of first column. The word "No" in the phrase "No claim is made that the device aids the team in overcoming the inertia of the car" should read, "The claim is made etc. In point of fact, this claim is one of the essential features of my invention. It is not founded on any supposition, but has been fully demonstrated by practical tests, and also substantiated by dynamometrical tests in an exhibit made before the Franklin Institute and others in this city. I hope you will kindly correct the statement in your next issue, as it is of too much importance not to be noticed by me and corrected by you. The references made as to my electrical device is very satisfactory and does justice to the merit of my invention.

JOHN H. PALMER.

[There was no typographical error, but it appears that our estimate of our correspondent's "claims" with regard to his invention was too small. Until we see the records of the dynamometrical tests, we shall be much inclined to doubt that an added leverage, lasting only for the first few inches of a car's travel, is of much practical account in getting a horse car under way.—ED. ENG. NEWS.]

Safe Building.

NEW YORK, Jan. 20, 1890.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: My attention has just been called to the review of my book, entitled "Safe Building," in your issue of Dec. 28, 1889. The spirit of the review and treatment of the book, I must say, on the whole is very fair. But the adverse criticisms, while apparently true, arise mainly from the fact that this part of the work was prematurely published, and that the publishers, instead of plainly marking the book as "Volume I," have adopted (what I believe to be) the English method of putting a single star on the cover and title-page. This single volume was never intended as the complete treatise, and this accounts for the omissions complained of in your review, viz., that "there is practically nothing upon plate girders, roof trusses, or wrought-iron frames," and that "there is no index." All these omissions will be remedied in due time by the publication of Volume II, the completed manuscript of which is now in the hands of the editor of the *American Architect*, in which paper all these articles appear as contributions before being published in book form. The headings of the chapters which will form the second volume will show that the work is not by any means one in which negligent omissions have taken place, and that it is not of a "sketchy character;" and I do not think that "every architect and engineer who follows your advice and buys it" will have much cause to "swear at the omissions," when he gets his second and last volume and the full index, which is about to be prepared by the publishers.

I append the headings of the chapters of the second volume, viz:

Chapter VIII. The Nature and Uses of Iron and Steel
" IX. Rivets Riveting, and Pins.
" X. Plate and Box Girders.
" XI. Graphical Analysis of Strains in Trusses
" XII. Wooden and Iron Trusses.
" XIII. Columns.

Also some 50 pages of useful reference tables.

Yours very truly,

LOUIS DE COPPET BERG.

[We know of no English nor other publishing custom which warrants the publication of what is really only Vol. I of a treatise as the complete treatise, without any reference in the volume itself to the fact that a second volume is to appear to complete the work. Certainly our reviewer had a right to assume that the complete work was before him.]

The Niagara Falls Suspension Bridge.

NEW YORK, Jan. 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: In the brief mention and notice of the death of Mr. SAMUEL KEEFER, contained in your issue of the 11th inst., the Highway Suspension Bridge at Niagara Falls is alluded to as one of his most noted works; and incidentally thereto, reference is made to the widening of the roadway from a single to a double way after the bridge had been in use for nearly twenty years, and to the destruction of this new roadway by the terrific wind-storm of Jan. 9 and 10 last. Based presumably upon the remarks made by Mr. KEEFER in his annual address for 1889, as President of the Canadian Society of Civil Engineers—an abstract of which address was published in your issue of Jan. 26, 1889—the statement is made that the original cables and anchorages of Mr. KEEFER were retained and used in the reconstruction or renewal of the bridge, and that they only withstood the force of the tornado, all the new work going down before it. Such was surely the impression and belief of Mr. KEEFER at the time of delivering his annual address, and for aught I know to the contrary, retained by him till his death; but such was not the fact.

The so-called enlargement was in reality an entire reconstruction of the bridge made during the winter of 1887-88, without interfering with the passage of vehicles or foot-passengers over the bridge whilst the work of reconstruction was going on. The bridge as built by Mr. KEEFER had a width of 10 ft, with two lines of wooden trusses 6 ft. in depth attached to two cables, each composed of seven iron wire ropes 2⅜ ins. diameter. The new bridge was made 17 ft. 6 ins. wide with two steel trusses 12 ft. in depth. The old or original cables were removed, and replaced with four new cables, each composed of seven cast-steel wire ropes 2¼ ins. diameter secured to a new anchorage built behind the original anchorages, which latter were also removed. It was these four new steel cables and the new anchorage that withstood, without the slightest injury to either, the violence of the tornado, and not those of Mr. KEEFER, which had been removed in the spring of 1888. The only parts of Mr. KEEFER'S original bridge made use of in the reconstruction of the work were two of the old cable ropes, and these were used as parabolic storm ropes to prevent excessive lateral motion of the roadway.

In replacing the fallen roadway after the tornado of January last, no changes were made either in the design or dimensions of the trusses or floor system, the work being rebuilt from the original drawings for this work of reconstruction. It may be of interest to state that the 1,250 ft. of roadway completed was erected in 21 working days and the bridge thrown open to travel again in a little over three months after the fall of the roadway.

G. W. MCNULTY.

Number of Freight Cars Equipped with Air Brakes—Correction.

PITTSBURG, Pa., Jan. 13, 1890.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: We note, with much interest, the exceedingly interesting publication on the subject of the progress in the use of automatic couplers and air brakes on freight cars, in your issue of Dec. 21, 1889. Your excellent analysis of the situation certainly puts the subject in a very strong light, and we feel quite sure it will prove of more than passing interest to all concerned. We are pleased to say that the map, about which we confess we had some misgivings as to its clearly illustrating the state of the art, shows up splendidly.

With reference to the statement on page 584 of the number of freight car brakes applied: With the close of December, 1889, we have furnished to railway companies and others, as you will note by enclosed copy, 101,576 brakes. Deducting from this about 2,000 brakes, which we furnished in December, would leave 99,000, or a discrepancy of 14,000, as compared with the sum total of the brakes applied according to your statement. We do not know where this discrepancy occurs as yet, but purpose looking it up and making such corrections as will be necessary.

H. H. WESTINGHOUSE
General Manager.

[The correction above makes the case even stronger than we showed it for the introduction of freight train brakes and couples. As Mr. WESTINGHOUSE himself is not able to specify just where the error is, it is not likely that we can do so; but we presume it arose from errors of omission by the various railway companies which favored us with returns, coupled with some corresponding omissions in statistics furnished us by the Westinghouse Brake Co. Some of the brakes furnished, also, have no doubt worn out or been destroyed by this time, and so gone out of service.—ED. ENG. NEWS.]

Grading Machines for Canal Work.

YUMA, ARIZONA, Jan. 3, 1890.

TO THE EDITOR OF ENGINEERING NEWS:—

SIR: In your issue of Nov. 30, 1889, is published a cut and descriptive article of the "New Era Grader and Ditcher." Some of the statements are incorrect and calculated to mislead contractors and others engaged in the construction of canals, for which purpose the machines are totally unfitted, and a qualifying word seems necessary.

The economical construction of small surface canals and lateral irrigating ditches (leaving out any consideration of providing for drainage crossed by the canal) requires the location to be such that the excavation shall make the embankment; that is, the excavation to grade shall provide sufficient dirt to built an embankment of desired cross-section on each side of the canal, of such a height that the depth of excavation plus the height of embankment shall equal the desired depth of the canal. This condition never can obtain exactly in practice, but the more nearly the quantities approach equality the cheaper will be the construction. It follows from this and also from the necessity of keeping the water above the natural surface of the ground so that it may be easily directed at any point, that fully 60 per cent. (usually more) of the work on any surface irrigating canal will consist in building artificial banks.

The difficulty in obtaining a good water-tight "joint" between the artificial embankment and the undisturbed earth beneath it is well known; and that the bank must be as solid as tamping, rolling, or the tramping of horses can make it, is self-evident. This fact alone condemns the machine for use in canal building, for surely no engineer would permit loose shovel-work on embankments intended to retain water and the "dropper" or "carrier" of the New Era Grader delivers the dirt in the bank in precisely the same condition as if it had been shoveled there.

The statement that the grader will work in any soil where a plow can be used, etc., is untrue. It will not work satisfactorily in any soil containing gravel-stones or which pulverizes readily. In the prairie States, where one often sees a furrow turned over without a break, the machine will handle fully as much dirt as is claimed and are well adapted for many purposes. But in the alluvial valleys of the Southwest, which are just coming into prominence agriculturally by the construction of irrigation systems, the soil and conditions differ from those for which the machines were designed. In these valleys the roads are covered with dust several inches in depth and so impalpably fine as to almost resemble a fluid in its action. After a few rounds over a "section" with this ponderous machine, with its twelve to sixteen horses, the earth to be moved has lost all cohesion and presents much the same condition as the dust in the roads, and the plow is no more able to elevate it to the "carrier" than if it

were a true fluid. There is much more which might be said both of the merits and demerits of these machines, but a fear that I have already occupied too much space compel me to stop.

L. A. HICKS.

[Our correspondent seems to speak from full knowledge of the condition in his locality and after a careful study of the subject. If his objections can be answered, it must be done by others than ourselves.—ED. ENG. NEWS.]

The Philadelphia & Reading Company's Report.

The recent excitement in financial circles concerning the inability of this company to pay the interest on the income bonds, with the efforts made to elect a new set of officers at the annual meeting, make the Annual Report of the company of more than usual interest. The following statement shows the results from operations of the railway and coal companies for the last fiscal year:

Total earnings of P. & R. R. R. Co.	$20,537,375
Total operating expenses	12,396,705
Net earnings	$8,140,670

From this is to be deducted interest and rentals amounting to $6,927,457.

Gross earnings P. & R. Coal & Iron Co.	$17,818,225
Gross expenditures	17,906,075
Deficiency	147,850
To which add interest	826,523
Deficiency	$974,373

The railway company is liable for $354,084 for sinking funds, and $790,200 for interest for the Coal & Iron Company, a total of $1,144,284. Subtracting this amount from the net earning of the railway company, minus interest and rentals, we have a surplus of $68,927 from the operations of both companies. The proportion of operating expenses to earnings inceeased 4.6 per cent. over that of the previous year.

In regard to this the Report says:

When the great improvement in the condition of the road, superstructure, buildings, and equipments is taken into account, together with the large and exceptional expenditures required to make good the destruction of property occasioned by the extraordinary floods of the past year, as well as the loss of gross revenue resulting from the consequent partial or total suspension of business on many portions of the lines during that period, it is a matter for congratulation that the proportion of operating expenses has been kept within that limit. This result has only been secured by the most rigid and exacting economies in every department of the service.

The general reduction in the rates of fare and freight and the decreased consumption of coal have operated to decrease the revenues of the company, while the necessity of placing the road in a condition to compete with its competitors in character of road bed and equipment have increased expenses. While many betterments are still to be made, they will become a rapidly diminishing quantity in the future, and will therefore leave a larger proportion of the earnings for distribution in the shape of interest and dividends.

Concerning the coal traffic the report says:

The management have constantly sought to extend the field of consumption for coal and the facilities for supply, and have no doubt that, with the prevalence of ordinary conditions of demand, both the railroad and coal companies would have been able to put upon the markets with economy and profit a large increase over the product for any year in the history of the companies.

. . . . . .

The falling off in tonnage from the anthracite coal field for the year amounts to nearly 3,000,000 tons, and a careful analysis of all the available statistics shows that the Reading Company has placed upon the market during the year nearly, if not quite, its full proportion of this tonnage, and has only suffered from the falling off in this traffic a due proportion with other corporations engaged in this business.

A brief history is given of the attempts made by the company to build an elevated railway by which its passenger trains may run with safety to the business center of Philadelphia. All efforts to obtain permissive legislation for this purpose from the Philadelphia City Councils have proved fruitless. The company, therefore, relying on the power granted it in its charter to build branch roads, has purchased right of way for nearly the whole of its proposed route. Legal proceedings were at once begun on behalf of the City of Philadelphia to prevent the construction of this road, and a decision in favor of the city was rendered by the Lower Court. The case has been appealed, however, and a renewed application has been made to the City Councils for permission to build and operate the proposed road.

A Heavy Grading Contract.

The city of Syracuse, N. Y., is now engaged in a grading contract that is probably the most extensive in central New York. This is the filling and grading of what is known as the "White Tract" in the Fifth Ward of that city. The area to be filled in is about 42 acres.

This tract was bought by Mr. H. G. WHITE, some years ago, for $30,000, and it was sold last June to Messrs. M. C. and A. W. PALMER for $75,000. Much of the tract is on the level of the original swamp, and to avoid the use of piles in the foundations of the buildings to be erected upon this site, the present proprietors have decided to fill the whole area to an average depth of 4 ft. The contract has been let to Mr. A. C. REYNOLDS, an old railroad contractor of Geneva, N. Y., and the amount of earth to be handled is estimated at about 250,000 cu. yds. A neighboring hill will furnish the material, and steam excavators, railway tracks, and locomotives will be used in the transfer. As the streets are already laid out, about 1½ miles of 18 and 24-in. sewers are now being laid. The engineer in charge of the work is Maj. H. W. CLARKE, Mem. Am. Soc. C. E.

The Central Dock and Terminal Railway Co.'s Plant, at Buffalo, N. Y.

The above named company has about completed, at the foot of Georgia St., Buffalo, N. Y., its extensive plant for the lake shipment of anthracite coal. The contract for this work was let, on Feb. 15, 1889, to Ellsworth, Chapman & Co., of Rochester and Watkins, N. Y.; work was commenced April 1, 1889, and it was completed in 268 working days.

The work done includes the main wharf, protection pier, retail pockets and approaches; the whole costing the sum of $300,000.

The main wharf is 75 ft. wide, 750 ft. long, 1316 ft. of vessel room, the slip on each side of wharf 90 ft. wide; 18 ft. of water. It is crib-work 27 ft. deep, filled with broken stone. Bents of pockets rest on piles. capped, entirely independent from crib-work. There are 80 pockets, 40 pockets on each side, average height of base of rail on pockets above top of wharf, 36 ft.; length 500 ft.; total, capacity 7,690 tons.

The protection pier is 650 ft. long, made of crib-work 24 ft. deep. It is 20 ft. wide, filled with broken stone and protected with a line of sheet piles riprapped with stone.

The retail pockets are 32 ft. high, 200 ft. long and 42 ft. wide; 16 pockets on each side, making 32 pockets, with a capacity of 3,200 tons.

The approach consists of three tracks, the two outer tracks ascending at the rate of 3 ft. per 100 ft. for loaded cars; the center track descending at the rate of 1 ft. per 100 ft. for the light cars. The length of approach is 1254.5 ft.; this also includes a skew iron bridge 101 ft. span; crossing the N. Y. C. & H. R. R. R. tracks. The total length of wharf and approach is 1804 5 ft.

The amount of material used and moved in the construction of this plant was as follows:

180,000 cu. yds. of dredging; 2,750,000 ft. B. M. of white pine; 250,000 ft. B. M. of white oak; 22 300 lin. ft. of piling; 74,000 lin. ft. of white pine logs; 156,000 lin. ft. of hemlock; 380,000 ft. B. M. of hemlock timber; 360 tons of iron bolts, spikes, plates, etc.; 187 tons iron in bridge; 38,802 cu. yds. stone filling; 1,500 cu. yds. of masonry; 12,000 cu. yds. of excavation.

Mr. A. F. CHAPMAN, of Watkins, N. Y., gave the work his personal attention, assisted by GEO. W. STORM, of Watkins, N. Y. JOHN FOREMAN, of Pottstown, Pa., was the designer of the work. DANIEL ULRICH, formerly of the "Erie," was engineer in charge of construction with J. A. ARCHBALD, Assistant Engineer; H. H. TYRRELL of Watkins, N. Y., was the Inspector. The Central Dock & Terminal Railway Co. has leased this entire plant to Albright & Co., of Buffalo, N. Y., for a term of twenty years.

Cost of Electric Lighting.

A correspondent having asked for a list of some cities where electric lights of 2,000 c. p. are used for all-night lighting, with the price paid and the approximate number of lamps in service, we have obtained the following information, and give it for the benefit of our readers. In each case the lamps are of the power mentioned above.

Cities.	No. of Lamps	Per Night.	Per Year	Contract
				Years.
New Haven, Ct.	146	47 cts.	———	3
Indianapolis, Ind.	100	60 "	———	2
Boston, Mass.	704	65 "	237.25	3
Brooklyn, N. Y.	1,106	—	182.50	1
Baltimore, Md.	587	50 "	182.50	(none)
New Orleans, La.	948	38 "	130.00	4
Pittsburg, Pa.	500	—	104.00	3
Providence, R. I.	247	—	182.50	1
Milwaukee, Wis.	135	—	150.00	3
Buffalo, N. Y.	1,130	45 "	164.25	1
San Francisco, Cal	102	55 "	—	—
Hartford, Ct.	124	33¼ cts. per hour	—	—
Kansas City, Mo.	65	54 "	—	—
Joliet, Ill.	69	38 "	—	—
Leavenworth, Kan.	35	33 "	—	—
Louisville, Ky.	50	63 "	—	—
Augusta, Me.	60	34 "	—	—
Lowell, Mass.	182	50 "	—	—
Detroit, Mich.	673	49 "	—	—

THE COST OF ELECTRIC LIGHTING for a number of towns is thus given by the Detroit *Free Press*:—

	Cents.		Cents.
Aurora, Ill.	15.2	Lyons, Ia.	8.2
Bay City, Mich.	16.	Madison, Ind.	16.
Champaign, Ill.	12.3	Michigan City, Ind.	12.
Chicago, Ill.	15.	Painesville, O.	10.6
Decatur, Ill.	13.7	Paris, Ill.	10.4
Dunkirk, N. Y.	13.5	Portsmouth, O.	10.
Easton, Pa.	27.3	Topeka, Kan.	20.
Grand Ledge, Mich.	11.8	Ypsilanti, Mich.	11.2
Huntington, Ind.	13.7		
Lewiston, Me.	14.	Av'r. cost per night	13.4

Brick Paving Specifications of Des Moines, Ia.

We are indebted to the courtesy of Mr. CHARLES BENNET, City Engineer of Des Moines, Iowa, for the following copy of the specifications used in that city for brick street pavement. Des Moines now has about ten miles of streets so paved, and Mr. BENNETT writes that if good material is properly laid it will give good results. Ordinary shaped brick are used, but every brick is carefully inspected. He does not approve of the single course of brick advocated by some towns.

Prepatory to laying, the street is graded to a true crown, as per plans, and the ground after being dressed is thoroughly tamped with an 81-lb. tamper, or rolled with a roller weighing not less than 150 lbs. per inch-length of roller. No plow can be used in the preparations of sub grade deeper than a line 4 ins. above the base of the ballast. All filling necessary is done in 9 in. layers thoroughly rolled and tamped. This preparatory specification applies to all manner of pavement. The brick laying is done as follows:

After the street is graded to the proper depth, as above described, a bed of sand 3 ins. deep is spread over it. On this bed is laid a course of brick flatwise, breaking joints as in a building and kept as close together as possible. On top of this first course sand is spread sufficient in quantity to fill the joints after a thorough sweeping; 1 in. of sand is then put down evenly and upon this is laid a second course of brick set on the edge and breaking joints as before. Sand is again swept into the joints and the whole pavement is finally completed with 1 in. of sand after it is thoroughly swept.

The bricks used are "regular shaped, ordinary sized brick, vitrified entirely through" and equal to samples furnished to the contractors by the Board of Public Works. Nothing less than a half-brick can be used in this pavement, and that only to fill out the line at the curbstones.

The Cincinnati, Hamilton & Dayton Collision.

Accommodation train No. 77 over the C. H. & D. R. R. is due in Cincinnati at 7.05 P. M., stopping at every station (17 in its 15 miles), and taking 45 minutes for its 17-mile run. The "Monon" vestibule express is due in Cincinnati at 7.10 P. M., 5 minutes later, starting from Hamilton, 25.4 miles out, at 6.25, and so making the run in 55 minutes, or at 36 miles per hour. As the last 5 or 6 miles are necessarily run at slow speed, this means a pretty high speed in ap-

proaching the scene of the accident, 6 miles out of Cincinnati. The entire track between Hamilton and Cincinnati is operated on the block system, from signal cabins. On the evening of Jan. 17, the accommodation train was 12 minutes late, and was also, most happily, very lightly loaded, having only some 30 passengers on it, only 5 of them in the rear car. Usually the train was well filled. It was on the block between Carthage, 9.3 miles out, and Winton Place, 6.7 miles out, when the following express reached the Carthage block in charge of a youth of eighteen, whose general competency does not seem to be questioned, but whose exceedingly improper and careless procedures (to what extent authorized by rules we are not at this moment prepared to say) are narrated in full on our editorial page. He "thought" the accommodation would get off the block in time; took down his red signal, displayed a white safety signal, and *then* began to hunt around for a green caution-lantern, which he found without oil, and so could not light.

Consequently the express thundered by, drawn by the powerful Strong locomotive, "A. G. Darwin," perhaps the heaviest and most powerful express locomotive in the world, with a distinct intimation from the signals that the accommodation was at least 2.6 miles ahead. As a matter of fact, it was at much less distance, and had just left Winton Place after a short stop when the express came in sight. An attempt was made to block it at Winton Place, and the engineer (so he claims, and probably with truth) at once put on the brakes, but within a few hundred feet the rear of the accommodation came in sight, and before the speed of the express was more than well checked the collision took place, probably at a differential speed of 20 to 30 miles per hour.

The accommodation consisted of five cars, a combination car in the rear. This at once telescoped the fourth car. The third car was badly wrecked, the first and second not seriously injured, the locomotive was kicked away from its train, breaking the coupling. Not a wheel of either train left the rails.

The cars were heated with common car stoves, one in the centre of each car, and from these or from the lamps the three wrecked cars at once took fire. Not a person escaped alive from the rear car, and of the five lives lost there, it is supposed that two or three were burned alive; from the fourth car it is possible that one or two escaped. The engineer and one fireman of the Strong locomotive were injured by jumping. It is difficult to see from the accounts why the express was not more promptly stopped by the brakes, the block signal at Winton Place having been seen.

It chanced that in this accident, as has happened in so many others, a subscriber of ours lived almost on the scene of the disaster, and he sends us the following letter in regard to it. We trust all our readers who may be near the scene of important railroad or engineering disasters will promptly do likewise, and we will again repeat that they are authorized to at once incur any reasonable outlay for traveling expenses, news, surveys and details, on our account.

By this mail I send you full accounts of the railroad holocaust that occurred within the limits of Spring Grove Cemetery on the C. H. & D. R. R. and also an engraving and full account of the great Strong locomotive, which has been exciting the wonder and admiration of railroad men in this vicinity for the past month. Although the accident occurred within one-half mile of my residence I cannot add anything to the printed accounts.

As a commuter I pass over the C. H. & D. from Winton Place to the city twice a day and sometimes in the evening. This has made me somewhat familiar with the way the trains are run. Formerly the C. H. & D. ran its trains with very great regularity. But of late, and particularly for the last two or three months, they have been running very irregularly.

By the inclosed timetable you will see that the express from Indianapolis (really the "Monon" from Chicago) is due in Cincinnati at 7.10 P. M., while the accommodation is due at 7.05.

I ride on this train whenever I have occasion to go into the city at night, and it is regularly running behind time, and of course running on the time of the express. You will also see by the timetable that between 7.00 and 7.55 A. M. there are five trains due in the city. The one arriving at 7.15 is the only one that has made any pretense of running on time. All the others are regularly from 5 to 20 minutes late. Such a state of affairs, it seems to me, is little short of criminal.

This very accommodation train was an example. It starts from Glendale [15 miles out] at 6.20 P. M., and in running to 8.3 miles the Winton Place had lost 12 minutes in a schedule run of 22 minutes.

We are not in a position to know how exact may be our correspondent's rather general statements, but our columns are open to contradiction, and in cases of this kind it appears to us proper that the views of intelligent professional observers of facts should be published on their merits.

The Forth Bridge.

(WITH INSET.)

The view of the Forth Bridge in this issue we reproduce from a photograph, for which we are indebted to *Engineering*. It shows the Fife cantilevers from the west, and is the best and most striking view of this structure that we have yet seen, and more clearly than any other gives the structural features of this great bridge.

In numerous preceding issues, the history of the Forth Bridge has been given in detail since the commencement of work; but it will not be out of place here to again briefly sketch the rise and progress of this remarkable structure, now practically completed.

The purpose of the Forth Bridge is to secure direct railway communication with the north of Scotland across the Firth of Forth, and in 1865 and 1873, two schemes for this purpose were sanctioned by Parliament, both from designs by Sir THOMAS BOUCH. The first plan called for four spans of 500 ft. each across the deep channel, and the second was for a stiffened suspension bridge of two 1,600 ft. spans with towers 665 ft. high. A contract was actually let to Messrs. ARROL & Co. and to Messrs. VICKERS on this latter plan for $5,780,000, and work was commenced upon it. But the failure of the Tay Bridge caused a suspension of work, in 1881, and the plans were submitted to the consulting engineers of the three railway companies concerned, that is, to Mr. HARRISON, Mr. BARLOW, and Sir JOHN FOWLER. These engineers recommended that the plan be changed to provide for a rolling load of 1,600 tons per track, instead of 600 tons, and a wind pressure allowance of 56 lbs. instead of 10 lbs. per sq. ft. These changes increased the estimated cost by from $3,000,000 to $3,500,000 and as a consequence the directors of the bridge company decided to abandon the work.

The Abandonment Bill passed the House of Commons, but was arrested there, and the North British, Great Northern, Northeastern and Midland railway companies, all of which were seeking a direct route to the north of Scotland, submitted the question to the engineers first named, and asked them to consider it anew, and in 1881 the bill under which the present bridge was virtually constructed was passed.

The first design presented by Sir JOHN FOWLER and Mr. BENJAMIN BAKER differed somewhat from the structure as now built in the arrangement of the main members and the cantilevers at their points of junction. But these changes were practically settled before the contract for erection was let, in December 1882, to Messrs. Sir THOMAS TANCRED, Mr. T. H. FALKINER, and Mr. JOSEPH PHILLIPS, as engineers and contractors, and Messrs. ARROL & Co. as builders. These firms subsequently joined under the name of Tancred, Arrol & Co. The contract price was $8,000,000.

We will not enter into the structural detail other than to say that, as constructed, each of the two channel spans is 1710 ft. long in the clear, and has a clear headway of 150 ft. under the bridge for a width of 500 ft. on the Queensferry side and 850 ft. on the Fife side. These great spans are made up of two 680-ft. cantilevers and a suspended span 350 ft. long. The cantilevers are 343 ft. deep over the piers and 40 ft. at the ends, and the bottom members are tubes tapering from a diameter of 12 ft. to 5 ft., spaced 120 ft. apart at the springing line and 31½ ft. apart at the top.

The top members are box lattice girders diminishing in depth from 12 to 5 ft., and 33 ft. apart at the piers and 22 ft. 3 in. at the ends. Each tube has a maximum gross sectional area of 890 sq. ins. and each girder a maximum net sectional area of 506 sq. ins. The rolling load provided for is (1) trains of unlimited length on both tracks, weighing 1 ton per lineal ft.; (2) on each track a train of two engines and tenders weighing 142 tons, heading a train of 60 trucks weighing 15 tons each; (3) a wind pressure of 56 lbs. per sq. ft., striking the whole or any part of the bridge at any angle, the total amount on the main spans being estimated at 7,900 tons. Under the combined stresses of worst position of loads and in the heaviest hurricane, the maximum stress on the steel used in construction will not exceed 7½ tons per sq. in. on any part of the bridge. On members subject to great variations in intensity and character of stresses, the maximum will not exceed 4 tons per sq. in. For the tubular columns and struts 34 and 37 ton steel, with an elongation of 17 per cent. in 8 ins., was specified; for tension members 30 to 33 ton steel, with 20 per cent. elongation, was required.

About the only serious mishap occurred on Jan. 1, 1885, in sinking the southwest Queensferry caisson. This caisson, loaded with 4,000 tons of concrete, stuck in the mud instead of rising with the tide, and the inflow of water caused it to tilt and slide out of position. It took about nine months to get it back again to its place.

A Manual of Railway Field Work and Laying Out of Works.

ACCORDING TO THE MOST RECENT AND APPROVED PRACTICE ON AMERICAN RAILWAYS.

BY A. M. WELLINGTON,
M.Am.Soc.C.E., M.Inst.C.E., etc.

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[The publication of Chapter III on Preliminary Surveys is omitted for the present, as also the whole of Part II, in order to publish as early as possible the matter relating to Transition Curves, in response to numerous requests. The Table of Contents for Part II is as follows:

(*Continued from page 20.*)

Part II. LOCATION WITHOUT TRANSITION CURVES.

Chap. IV. Continuous or "Straight Ahead" Location and Problems required therefor.
" V. "Backing Up" and Problems relating thereto.
" VI. Passing Obstacles and Problems relating thereto.
" VII. Shifting and Connecting Lines, and Problems relating thereto.

Part III. LOCATION WITH TRANSITION CURVES.

CHAPTER VIII. THEORY OF TRANSITION CURVES.

A TRANSITION CURVE is, as its name implies, a short curve of varying radius, interpolated between circular curves and their tangents in order to make the passage from one to the other less abrupt. A proper system of transition curves has also the practical convenience of greatly simplifying the field-work of connecting, adjusting, and re-adjusting lines, while not adding sensibly to the time required for the first continuous location. In order that the practical work of laying out transition curves may be thus simple, however, the theory of the subject must first be fully understood.

Let the axial line $M\ A\ B\ C\ D\ E\ N$, Fig. 1, represent to scale the located center line of a railway, composed of alternate curves and tangents, and let the successive points, A, B, C, D, be the *P. C.* or *P. T.* of circular curves, the distances $A\ B$, $C\ D$, being the connecting tangents, and the straight lines $M\ A$, $B\ C$, $D\ E$, etc., representing the curves. Erect at the beginning and end of each circular arc an ordinate $M\ O$, $A\ F$, $G\ B$, $H\ C$, etc., equal by any scale to the degree of the curve at that point; and above or below the axial line according as the curve is to the right or to the left; and connect the points $O\ F$, $G\ H$, $I\ J$, $K\ L$, etc., by right lines.

Then, since the degree of the curve is the same in all parts of a circular arc, the lines $O\ F$, $G\ H$, etc., will be parallel with the axis $M\ N$, and the quadrilaterals $B\ G\ H\ C$, etc., will be rectangles, and of an area equal by scale to the *total central angle* of the curve. Furthermore, if from any point B at a distance $B\ B'$ from the *P. C.*, a perpendicular be erected cutting $G\ H$ in G', the ordinate $B'\ G'$ will also represent to scale the degree of the curve. The rectangle $G\ B\ B'\ G'$ will equal by scale the total central angle consumed by the curve in the distance $B\ B'$, and the remaining rectangle $G'\ B'\ C\ H$ the remaining central angle.

In the case of a compound curve, as $D\ N$, the ordinates $E\ J$ and $E\ K$ will equal by scale the respective degrees of curvature on each side of the *P. C. C.*, E; and the difference, $J\ K$, of these offsets will equal by scale the difference in the degrees of curvature. In the case of a reversed curve, as $K\ L\ P$, the offsets $N\ L$ and $N\ P$ will equal by scale the degrees of curvature on each side of the *P. R. C.*, N;

and the sum, $L\ P$, of these offsets will equal by scale the sum of the degrees of curvature, or the total change in rate of curvature.

The necessity for transition curves to connect the tangents and circular curves arises from the abruptness of the offsets $A\ F, G\ B, D\ I, J\ K, L\ P$. On the tangents $A\ B, C\ D$, assuming everything in good order, the motion of railway vehicles is perfectly smooth and even; the axis of the car truck is at a constant angle of 0° with the axis of the car bodies, and there are no forces of any kind tending to cause irregular or uneven motion. Similarly on the curves, $G\ H, K\ L$, etc., the curve having been once entered, and still assuming everything in good order, the motion is likewise perfectly smooth and even, and there are no forces of any kind tending to cause irregular or uneven motion. The axis of the trucks remains at a constant angle of $A°$ with the axis of the car bodies; the centrifugal force is

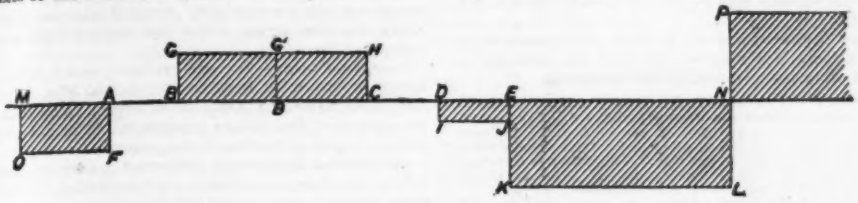

Fig. 1.

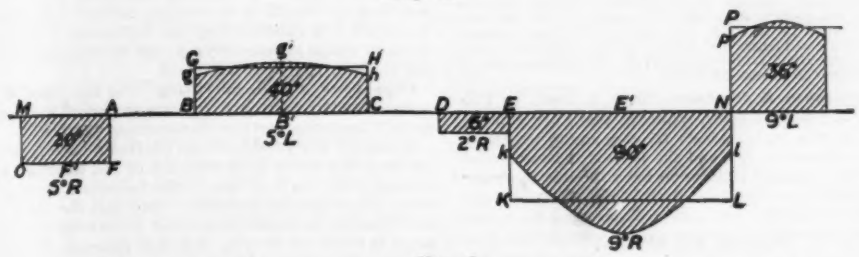

Fig. 2.

constant and uniform, and is balanced and nullified by a corresponding constant and uniform super-elevation of the outer rail, so that the passenger with his eyes shut has no means of knowing that he is on a curve at all, the car being to his senses level, although really canted, and his body, if standing or sitting erect, being and remaining perpendicular to the car floor.

But in the passage from the tangent to the curve or vice versa, these conditions do not prevail. The car must *suddenly* assume a curvilinear path, and the truck must be *suddenly* twisted from its previous permanent position through a considerable angle. Furthermore, the elevation required to balance the centrifugal force is as great at the *P. C.* or *P. T.* as in the middle of the curve, since the radius of curvature is the same, but as the transition from a level to a canted track cannot be made abruptly, the track must for a considerable distance be canted more or less than the curvature demands. If the super-elevation does not begin until the *P. C.* be reached, the centrifugal force there suddenly generated is entirely unbalanced, with the result of giving a dangerous and destructive lurch to the car and a disagreeable lurch to the body of the passenger. If the super-elevation be equally divided between certain distances on each side of the *P. C.*, an unbalanced centripetal force is first created, to which the car and the passengers adjust themselves, and this at the *P. C.* is instantly changed into an equally great centrifugal force, with results equally disagreeable to the passenger and but little less dangerous and provocative of wear and tear, since the sudden twist of the truck remains unaltered, and the sudden reversal of strain from $-\frac{1}{8}$ to $+\frac{1}{8}$ of the centrifugal force has but slightly less injurious effect than the sudden application of the whole centrifugal force where none previously existed.

If with a view to decreasing this evil we connect the same tangents and tangent points by parabolic instead of circular arcs, we shall obtain curves (see demonstration of the nature of parabolic curves) which are of a longer radius at the *P. C.*'s, and *P. T.*s, indeed, than the circular arcs, but ordinarily only slightly longer, while the curve is correspondingly sharpened in the center. We shall then have the conditions represented in Fig. 2, in which the dotted lines represent the corresponding conditions existing with circular arcs, as shown in Fig. 1. Since the "degree" of curve is not uniform, but decreases constantly each way from the center to the ends, the ordinates $B\ g$, $B'\ g'$, $C\ h$ are not uniform and the line $g\ g'\ h$ is neither straight nor parallel with $B\ C$, but must be either a broken or curved line convex to the axis $B\ C$. Whatever its form, since the total central angle remains the same, we have

$$\text{Area } B\ g\ g'\ h\ C = \text{Area } B\ G\ H\ C.$$

The ratios of the degree of a circular arc to the initial and central degrees of a parabolic arc have been already determined in § . For short curves of less than 30° the differences were found to be practically insignificant. For extremes of what may be called longer curves, they were:

Central Angle	Degree of Circular Curve	Degree of Parabolic Curve between same *P. C.* and *P. T.*	
		Initial	Central
30°	1.00	0.970	1.015
40°	1.00	0.883	1.064
90°	1.00	0.500	1.414

Fig. 2 represents to scale the comparative conditions for 20°, 40° and 90° central angle. It will be seen that, until the central angle becomes very great, the terminal ordinates Bg and Ch are only slightly less than BG and HC, so that the evils of the transition from curve to tangent and vice versa are only slightly alleviated, with the contravening disadvantage that the curve is made sharper in the center. With longer curves, of 90° central angle, the degree at the *P. C.* and *P. T.*, and consequent shock, is reduced one half, but at the expense of materially sharpening the central radius. For still greater central angles the easing of radius at the *P. C.* would become more considerable, but the central radius would be so much shortened as to be inadmissible. Parabolic curves cannot be used there-

Fig. 3.

fore to include a much larger central angle than 90°. Were there a much larger angle to be included, the curve would have to be divided into two, by a central tangent, giving the conditions outlined in Fig. 3.

The three preceding diagrams bring out the fact that while in no case is the amelioration of conditions as to radii by the use of parabolas considerable, a new unfavorable effect is created by them. Inasmuch as the degree of a parabolic curve is constantly changing, and the change is very slow, the angle of the axis of the trucks to the axis of the car is likewise constantly changing, but with extreme slowness. Under these conditions the coefficient of friction between the center plates becomes a maximum, and the flange pressure and danger of the center plates binding and causing derailment are both materially increased.

With the parabola, it is true, unlike the circle, it is unnecessary to have the tangents equal, and should unequal tangents be used we shall *at one end* of the curve ameliorate still more the transition from tangent to curve, but at the expense of introducing less favorable conditions at the other end. Fig. 4 represents the comparative conditions.*

* Drawn to scale from an actual illustrative curve given on p. 72.7 of Henck's Field-Book.

We have in Fig. 4, area $B'\ G'\ H'\ C$ = area $B\ G\ H\ C$ and the average degree of curves less in the proportion of $\frac{B\ C}{B'\ C}$, but the terminal radii become very

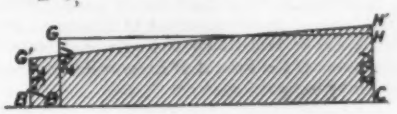

Fig. 4.

unequal and at one end of the curve the radius is still shorter than with a circular curve laid out with tangents equal to the shorter tangent.

We may now see, still more clearly than in Chap. 2, that the parabola is under no conditions a desirable railway curve as compared with a circle, even if it were easier instead of harder to fit to the ground and lay out. It is fortunate therefore that it is so much less convenient to lay out that it has never come into use.

What is required to obtain the most favorable conditions is that at some point A, Fig. 5, where super-elevation begins, curvature should likewise begin, but at a very easy rate; and that the degree of curvature should thence increase gradually and uniformly, and yet quickly, until at some point E the degree of the main curve is attained, and likewise the full super-elevation for it, from which point

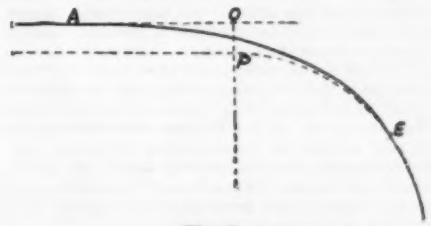

Fig. 5.

the degree of the curve continues unchanged until the further end of the curve is approached, where there is needed a like transition from the curve to the tangent.

The centrifugal force will then be created gradually, and be exactly balanced at every point by a gradually increasing centripetal force from the super-elevation if the latter be precisely adapted to the speed; or if not, the aggregate will be less and gradually created. The center plates of the trucks will move through the necessary angle quickly, but not too quickly, and thereafter remain unchanged until the curve is left.

Since the degree of the curve is no longer everywhere the same, on a curve so laid out with eased approaches, it is apparent that it cannot be represented by a rectangle like $G\ B\ H\ C$, Figs, 1 and 6,

Fig. 6.

but must rather be represented by a quadrilateral of the general form $A\ E\ F\ D$, Fig. 6, in which the terminal triangular areas $A\ E\ I$ and $F\ K\ D$ represent those terminal parts of the curve where the degree of the curve is gradually increasing from 0° to $D°$, and the rectangle $E\ I\ F\ O$ represents the unchanged circular $D°$ curve. If, as must in practice be assumed, the total central angle consumed by the curve is to remain constant, we have

$$\text{Area } A\ E\ F\ D = \text{Area } G\ B\ H\ C$$

and inasmuch as the rectangle $E\ I\ F\ K$ is common to both curves, we have further

Rectangle $G\ I$ + rectangle $F\ C$ = + triangle $F\ K\ D$, triangle $A\ E\ I$.

And if the rectangle $E\ I\ F\ K$ (that is, the central part of the curve) is to remain constant in position or "station" as well as in magnitude, we have further:

Rectangle $G\ I$ = Triangle $A\ E\ I$, and
Rectangle $F\ C$ = Triangle $F\ K\ B$.

These latter areas will equal by scale the total central angles consumed by the non-circular or "transition" part of the curve, and an ordinate, as $L\ B$, to the line $A\ E$ from any point, as B, on the axis $A\ D$, will equal by scale the degree of the transition curve at that point.

It is evident geometrically from Fig. 5 that a curve of this kind cannot be laid down except by in-

creasing the total length of the curve at the expense of the tangents, by extending it out upon the tangents.

It is also evident that the precise length of the line $A\ I$, in Figs. 5 and 6 (that is, the length of the transition curve), is not involved in satisfying any conditions as yet laid down, the sole requirement being that area $G\ I$ = area $A\ E\ I$, regardless of what that area may be.

It is also evident that if the increase of curvature is to be perfectly regular between the tangent at A and the main curve at E, the line $A\ E$ must be a right line.

[TO BE CONTINUED.]

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, New Haven & Harftord.—The four tracking on this road between South Norwalk and Westport, a section of 3 miles, is being rapidly pushed. This work is being done by contract and a large force of men are employed. It is estimated that the contract will require an expenditure of over $100,000. This work will reduce a heavy grade of 48 ft. to the mile to 30 ft. In the long cut the grade will be reduced 12 ft, which will require a large amount of rock cutting.

On the Shore Line the work of double tracking is well under way. From Clinton to Block Hall, 13 miles, the road is graded and is ready for two tracks. At East Lyme another section of road has been built. At this point the road is diverted for quite a distance, thereby avoiding a couple of pile bridges.

Deer Creek & Susquehanna.—At a meeting of the stockholders of this company recently held, a report was presented, by the directors in which it was stated that early in 1889 work of construction was commenced on this road and that up to date seven miles had been graded, five trestles erected, and the timbers for others purchased and prepared for erection. The work of construction, it is stated, will be resumed in the spring and the road will be built as rapidly as possible.

Baltimore & Drum Point.—A bill is before Congress incorporating the Columbia Central R. R. Co., in the interest of this company, with the authority to build lines of surface or elevated railway from the main line of the Drum Point R. R. into the city of Washington D. C.

Baltimore & Eastern Shore.—Work, which was temporarily abandoned, has been resumed. A large force of men are at work between St. Michael's, Md., and Eastern Bay and it is expected to have this division completed soon. Work is also in progress between Easton, Md., and the Choptank River, and in Caroline County. The force at work on the Wicomico side of the Nanticoke River has extended the embankment 3,700 ft. and work is now in progress on the piling for the bridge.

Ulster & Delaware.—It is stated that this company has promised to extend the branch built last year from Hobart to Bloomville, N. Y., to Delhi to connect with the New York, Ontario & Western R. R. on condition that the right of way be donated.

Central Vermont.—Surveys have been completed for the line from Bellows Falls to Windsor, and the engineers are now looking over the route from Windsor to Springfield, Vt.

Baltimore & Ohio.—Surveys are in progress for a line of railway from Bellaire, O., to East Liverpool, O. ——The engineers are making good progress on the surveys for the line from Ayndam, Bedford County, Pa., to a connection with the Western Maryland R. R. near Chambersburg, Pa.——The survey for the line from McKeesport, Pa., to Jeannette, Md., has been completed.

Wilkesbarre & Western.—At the annual meeting of the stockholders recently held, the following directors and officers were elected: JOSEPH GAZZAM, President; T. W. KENNEDY, MORRIS LIVERIGHT, JOHN B. STETSON; CHARLES D. BARNEY, W. C. DE ARMOND, JNO. M. SHARP, MAX BAMBERGER, of Philadelphia, and CHARLES RAHT, of New York City. ROBT. C. BELLVILLE, was appointed Secretary and Treasurer. The road is now in operation from Watsontown to Roherburg, Pa., 25 miles, and will be completed to Shickshinny, Pa, this year. The road forms a short route from the West Branch lumber region and the anthracite coal fields.

New York, Ontario & Western.—The annual report of this company, for the year ending Sept. 30, 1889, shows the following results from operations as compared with the previous year;

	1889	1888
Gross earnings	$1,782,327	$1,683,697
Operating expenses and taxes	1,509,453	1,428,218
Net earnings	$272,884	$255,479

Of the $10,000,000 of bonds authorized during the year $3,500,000 have been sold and the proceeds devoted to the acquirement of the Ontario, Carbondale & Scranton R. R. This line will, upon its completion give the company a line into the anthracite coal fields of Pennsylvania. The road will be 54 miles long, and it is expected that the greater portion of the work will be finished by March 1, 1890.

Philadelphia & Reading.—On the Philadelphia & Atlantic City railway the grading for the second track is nearly finished and tracklaying is to begin soon. The line will be laid with 76-lb. steel rail on both tracks for the whole distance: Engineers were sent out last week to survey the extension of the Northeast Pennsylvania Railway from Doylestown to New Hope on the Delaware River, about 18 miles. It is thought the line will be built the present season. The two bridges at Muncy and at Milton, Pa., to replace the old Howe trusses with strengthening arches which were carried away by the floods of last May, are about completed, the Muncy bridge carries double tracks and has six spans each about 160 ft. in length. The Milton bridge is single track. The west channel of the river is crossed by four 150-ft. spans, the east channel has 2 spans of 150 ft. and 2 spans of 195 ft. The bridge at Falls of Schuylkill now approaching completion is a double track structure on a 6° curve. It has 9 spans, one of 92 ft. 8 ins., one of 60 ft., six of 87 ft. and one stone arch of 80 ft. The iron spans are all deck riveted girders.

Lower Laurentian.—C. A. SCOTT, of Quebec, P. Q. the contractor for building this road has furnished us the following data concerning the enterprise;

The road is to run from Three Rivers, on the St. Lawrence River, to Riverie-a-Pierre station on the Quebec & Lake St. John Ry., a distance of about 70 miles. About 20 miles are now completed and the contracts have been let for the remainder of the line. The route is through a good farming and timber country. The maximum grade is 1¼ per cent, and the maximum curve is 6°. Nearly all of the right of way has been secured and about $100,000 of other local aid obtained from the towns along the route. About 10 miles of the grading on the new line has been completed. No work is now in progress except in getting out ties and bridge timber. Tracklaying will begin about May 1, and 40 miles of the road be open for traffic by Nov. 1. JAMES CADMAN is the engineer in charge of work.

Philadelphia & Seashore.—Mr. J. A. SENO, of Folsom, N. J. the contractor, writes us that work is being pushed on this road. About 125 men and 60 teams are now at work on the line and the force is to be increased soon. The company expects to have the line in operation by May 1.

Projects and Surveys.

Plymouth & Bourndale.—A correspondent has furnished us with the following information:

This proposed road, which is a scheme that has been periodically agitated for many years, is to run from Plymouth, Mass., south along the coast to a connection with the Old Colony R. R. at or near Bourndale, Mass., a distance of about 22 miles. The road will shorten the distance from Boston to Cape Cod and will give Plymouth another outlet. It is thought that if the citizens of Plymouth will assume their share in the cost of the enterprise, it will be carried out. HORACE R. TAYLOR and several other wealthy men are interested in the enterprise and stand ready to aid it with their money providing the people show a sufficient interest. A committee has been appointed to carry out the preliminary work. HENRY A. HANCOX, of Hudson, Mass., has been appointed to make the necessary surveys and estimates for the line.

Ashbourne, Cheltenham & Philadelphia.—Chartered in Pennsylvania to build a line of railway from Ashbourne Station on the Philadelphia & Reading R. R. to Cheltenham Station on the Philadelphia, Newtown & New York R. R. a distance of 3 miles. ROBT. ALEXANDER, of Philadelphia, Pa., is President.

Maynard Branch.—This road is projected to run from the Central Massachusetts R. R., at Sudbury, Mass. to Maynard, Mass., a distance of 5 3 miles. The projectors are several gentlemen interested in the Assabet Manufacturing Co., of Maynard, who wish to obtain an outlet for the products of the company. The work of the road will be generally light. H. A. HANCOX, of Hudson, Mass., Chief Engineer, has completed the surveys and estimates for the road.

Fort Plain & Richfield Springs.—Proposals for the construction of portions of this road have been advertised for. The road is projected to run from Ft. Plain, N. Y., to Richfield Springs, N. Y., a distance of about 30 miles. WM. CLARK of Fort Plain is interested.

Fort Plain, Johnstown & Saratoga.—Surveys for this New York road have been completed. The distance is 95 miles and the road is estimated to cost $1,000,000. WM. CLARK, Ft. Plain, N. Y., is interested.

Marlboro & Sudbury—The survey for this proposed road has just been completed by H. A. HANCOX, of Hudson, Mass., Chief Engineer. The road is projected to run from South Sudbury, Mass., to a connection with the Central Massachusetts R. R., a distance of 6.1 miles There will be a rise of 248 ft. in the length of the road. The maximum grade is 1½ per cent.

Canadian Atlantic.—The Canadian Parliament will be asked for a charter authorizing this company to build a railway from Quebec to St. Charles Bay, Labrador. The company has just been organized in London, England, with a capital stock of $40,000,000. E. P. BENDER, of Quebec, P. Q., is one of the incorporators.

Oley Valley.—A project is on foot to build a line of railway from Reading, Pa., through the Oley Valley opening up a rich farming country. GEO. BROOKE, of Birdsboro, Pa., is President.

Wyomissing.—This company proposes to build a railway from Reading to Mohrsville, Pa., a distance of about 5 miles. GEO. BROOKE, of Birdsboro, Pa., is President.

Potomac Valley.—Incorporated in Maryland to build a line of railway from Williamsport, Md., to a connection with the Baltimore & Ohio R. R., at a point between North Mountain and Cherry Run. Among the incorporators are: F. F. MCCOMAS, JAS. FINDLAY and others.

Phillips & Rangeley.—W. A. RICH, General Manager is reported as saying that the stock of this company has all been subscribed. The road will be 27 miles long, running from Phillips to Rangely, Me., and is estimated to cost about $7,000 per mile. Ties for the road are being cut, and as soon as the weather permits a large force of men will be put at work, and the road completed by Jan. 1, 1891. The road will be 2-ft. gauge. Contracts for the rails and rolling stock are now being let. B. F. CHADBOURN, of Gorham, Me., is locating engineer.

SOUTHERN.—Existing Roads.

Florida Central & Peninsula.—Work on the extension from Plant City to Tampa, Fla., 22½ miles is making good progress and it is expected that the line will be completed within one month. About 8 miles are graded ready for tracklaying which has already been commenced at Plant City.

Georgia Pacific.—The surveys have been completed for the line from Ita Bena to Jonestown, Miss. From Jonestown to Helena, Ark., the distance is 14 miles and the citizens of Helena are endeavoring to secure a further extension of the line to that place.

Nashville & Knoxville.—This road is now in operation to the Caney Fork River and tracklaying has been completed to a point 8 miles beyond the river.

Alabama Midland.—The line from Troy, Ala., to the Northwest & Florida R. R. is being rapidly completed. Trains are now running from the Northwest & Florida R. R. to within 15 miles of Troy, and the ties have been laid to within 6 miles of that place.

Cape Fear & Yadkin Valley.—The line from Wilmington to Fayetteville, N. C. has been opened for traffic from Wilmington north to Parkersburg, 62 miles.

Seaboard Air Line.—All the contracts have been let for the construction of that portion of the Georgia, Carolina & Northern R. R. east of the Savannah River and work is making good progress. Contracts for the division from the Savannah River west to Athens, Ga., will be let in about one month. It is also probable that contracts for the division from Athens to Atlanta, Ga., will be let soon. R. H. HOKE, of Raleigh, N. C., is President.

Columbia, Newberry & Laurens.—Tracklaying on the division from the Broad River to Prosperity, S. C., 35 miles, will begin about Feb. 1. The line is all graded.

Craig Mineral.—About 200 men are now at work on the line of this road from Eagle Rock towards New Castle Va., about 5 miles. This work is all heavy rockwork. As soon as spring opens a large force of men will be put at work and the road will probably be completed by Sept. 1, 1890. W. G. SEARS, of Eagle Rock, Va., is General Manager.

Savannah, Americus & Montgomery.—This road is completed from Abbeville, Ga., nearly to Sterling, where connection will be made with the Central R. R. of Georgia, which is building west from Savannah, Ga.

Projects and Surveys.

Florida, Midland & Georgia.—W. S. WEST, of Valdosta, Ga., sends us the following information concerning this enterprise:

The road is projected to run from Valdosta south, via Madison, Fla., to Deadman's Bay, on the Gulf coast, a distance of about 90 miles. The line has been surveyed once but will probably be resurveyed sometime in February. The route is through a level country a portion of which is low and interspersed with small ponds. There will be only one large bridge. The local traffic will consist mainly in lumber, naval stores, and cotton. The right of way has been obtained from Valdosta to Madison. Contracts will probably be let in Februrary or March. Some 14 or 15 miles of the roadbed of this road was partly graded about five years ago. W. B. THOMAS, of Tennille, Ga., is interested.

Knoxville & Northeastern.—Work on the construction of this road will, it is stated, commence in a short time. The road is projected to run from Knoxville, Tenn., northeast to Dandridge, Tenn., and ultimately further northeast to some point not yet determined upon. W. A. PARK, of Knoxville, is Chief Engineer.

Brookhaven & Monticello.—A project is on foot to build a railway from Brookhaven to Monticello, Miss., a distance of about 20 miles.

Memphis & Knoxville.—This company was chartered about 20 years ago to build a line of railway through Fayetteville, Pulaski, Waynesboro, and Lawrenceburg to Memphis, Tenn. The company graded some 20 miles of the road at that time and nothing has been done since. A project is now on foot to resuscitate the enterprise. The road will run through a rich mineral and agricultural section of the country now unsupplied with railways.

NORTHWEST.—Existing Roads.

Davenport, Iowa & Dakota.—An official of this road is quoted as saying that it will undoubtedly be pushed to completion this year. The track is now laid from Davenport to Bennett, Ia., and the roadbed is graded 9 miles beyond that point. Grading has also been completed from Riceville to Otterville, Ia., 75 miles. The

road is projected to run from its present terminus to Clarence, Anamosa, and Independence, Ia., and thence along the Wapsiepinecon Valley to a connection with the Northern Pacific R. R. in North Dakota.

Pacific Short Line.—A director of this company is reported as saying that the surveys had all been made and the necessary arrangements completed for commencing work on the construction of the line from Ogden, Utah, east.

Chicago, Lake Geneva & Pacific. — At the annual meeting of the stockholders recently held the following directors were elected: J. E. HEG, of Lake Geneva, Wis.; JNO. MATHESON, of Elkhorn, Wis.; U. S. GREEN, of Ft. Atkinson, Wis.; GEO. W. ESTERLY, of Whitewater, Wis.; W. A. P. MORRIS, of Jefferson, Wis., President, and CHAS. M. MORRIS, of Madison, Wis., Secretary. It is announced that arrangements have been made to begin the construction of the road at an early date. The company was chartered some years ago to build a railway from Lake Geneva, Wis., via Elkhorn, Whitewater and Jefferson, to Portage, Wis., and a portion of the roadbed has been graded. Nothing has been done for some time.

Winona & Southwestern.—This company has issued a statement asking the various towns along its proposed route to renew the aid heretofore voted by them but which has lapsed on account of the failure of the company to build the road in the stipulated time. It is stated that the company will build 100 miles of road this year.

Projects and Surveys.

Winnipeg & Southeastern.—It is now announced that this company is on a solid basis and that work on its proposed road will commence shortly.

Superior Belt Line.—The incorporators of this company have received a patent for the construction of this road. The road is to run from St. Louis Bay around the City of Superior and Allouez Bay.

St. Louis, Venice & Alton.—A press dispatch states that a railway company has been incorperated with the above name to build a railway from Alton, Ill., to the approach of the Merchants' Bridge near Venice. The incorporators are: JOHN AVERALL and GEO. GREENWOOD, of St. Louis, Mo., and H. M. NEEDLES, of Belleville, Ill.

Alton, Venice & St. Louis.—The incorporators of this company have elected the following officers: President, Z. B. JOB; Secretary, H. J. BOWMAN; Treasurer, Z. B. JOB, Jr.; Executive Committee, Z. B. JOB, R. E. MILLS, F. MCCAMBRIDGE, JOHN WEDIG, W. ELIOT SMITH.

SOUTHWEST.—Existing Roads.

Chicago, Burlington & Quincy.—A press report states that this company is making surveys for a line from St. Peters to St. Louis, Mo. The company now uses the tracks of the Wabash Western R. R. between those two places.

Batesville & Brinkley.—The directors of the White & Black River Valley R. R. have decided to mortgage the road for the purpose of raising funds with which to build the extensions from Brinkley to Helena, Ark., and from Newport to the Missouri State line to connect with the St. Louis & San Francisco R. R.

Austin & Northwestern.—Engineers are reported at work making surveys for an extension of this road from Marble Falls to Johnson City, Tex.

San Antonio & Aransas Pass.—Tracklaying on the Waco Branch has been completed from Waco to Chilton Tex., and the road put in operation.

Texas & Pacific.—Surveys are in progress for a line from Gloster, La., to Waskom, Tex. The object of the line is to shorten the distance from the west to New Orleans by avoiding the long detour by the way of Shreveport, La.

Projects and Surveys.

Arkansas Gulf.—W. R. BIRGHALZ, of 15 Cortlandt St., New York City, President, writes us that this road is projected to run from Pendleton, Ark., via Arkansas City to the Louisiana State line, a distance of 85 miles. The route is through a level country; maximum grade 25 ft per mile. There will be a large bridge across the Arkansas River. The principal business of the road will be in cotton and timber. Contracts for construction will probably be let in February.

Gulf & Northwestern.—This road is projected to run from Orange, Tex., north through the counties of Orange, Newton, and Jasper to a northern connection not yet determined upon. The officers are: G. BEDELL MOORE, President, D. CALL, Vice-President, W. H. STARK, Secretary, and W. S. DAVIDSON, Treasurer.

Texarkana & Sabine Pass.—A project is being talked of to build a railway from Texarkana, Tex., to Sabine Pass, on the Gulf Coast. The object is to connect with the Kansas City, Fort Smith & Southern R. R. at Texarkana and thus complete a through line from Kansas City, Mo., to the Gulf coast. D. P. Doak & Co., of Kansas City, are interested.

ROCKY MT. AND PACIFIC.—Existing Roads.

Union Pacific.—Surveys are in progress for the extension of the Cheyenne & Northern R. R., to a connection with the Chicago & Northwestern R. R. at Fisher Station. It is stated that as soon as the line is located work will commence. Kilpatrick Bros. & Collins are the contractors. The length of the extension will be about 30 miles and it is to be completed by June 1, 1890.—Contracts for the large shops at Omaha, Neb., are reported let to Lantry Bros. & Co.

Projects and Surveys.

Southwestern.—JOHN WATSON, of Chino, Cal., writes us that this company is not yet fully organized. It was formed to absorb the Pomona & Elsinore and the San Diego Elmore Railway companies, and in addition to build a line from Pomona to Los Angeles, Cal., and from San Bernardino, via Colton and Riverside south to San Diego, with a branch to Los Angeles.

San Joaquin Valley.—Chartered in California to build a railway from Freano, Cal., up King's River to timber lands, a distance of about 75 miles.

Denver Resort.—Surveys have been commenced for this road which is projected to run from Denver, Col., to Lookout Mountain, a distance of 16 miles. The object of the road is to connect Denver with the summer resort on the mountain. The road will be double track. R. W. WOODBURY, of Denver, is one of the incorporators.

FOREIGN.

Vanegas, Cedral & Rio Verde.—We have received the following information from H. H. LEIBERMAN, of Cedral, Mex., Chief Engineer:

The road is projected to run from Vanegas, on the Mexican National Ry., via Cedral, Matehuala, and Tula to Rio Verde, a distance of about 223 miles. Twenty-eight miles of the road are now in operation, 12 miles are graded ready for the rails, and the surveys have been completed on 40 miles more. There will be one iron bridge 380 ft. long. The principal business of the road will be in ore, fruit, timber, and hides. All of the right of way has been secured, and the Government has granted a subsidy of $6,200 per kilometer in aid of the enterprise. FELIPE MURIEDAS, of San Luis Potosi Mex., is President.

Russia.—The Czar has approved the project to construct a railway on the shore of the Black Sea, from Novorossisk to Novosenck.

RAPID TRANSIT.

Electric Railways.—*Springfield, Mass.*—The street railway company has adopted the Thomson-Houston system for the Forest Park extension. The line is to be completed by May.

New York, N. Y.—The 42d St., Manhattanville & St. Nicholas Ave. Ry. Co. is contemplating the use of electricity on the Boulevard line.

Lancaster, Pa.—The Lancaster ElectricSt. Ry. Co. has been organized by the consolidation of the Lancaster and the East End Street railway companies. President, JOHN A. COYLE; Secretary, J. E. ACKLEY.

Pittsburg, Pa.—The Federal St. & Pleasant Valley Ry. Co. is interested in a new electric line to Reserve, township. The road will cost about $75,000. President D. F. HENRY.

Richmond, Va.—The Richmond Ry. & Electric Co. has been organized by JOSEPH BRYAN and W. R. TRIGG, of Richmond; D. H. HOUGHTALING, JOHN H. MANN, and G. E. FISNER, of New York. The object is to consolidate the several street railway interests.

Knoxville, Tenn.—The Fountain Head Ry. Co. has been granted permission to build an electric line on Central Ave.

Winston, N. C.—The Salem & Winston electric line has been purchased by F. J. SPRAGUE, E. M. JOHNSON, and J. H. MCCLEMENT, of New York, E. L. HAWKS, of Lexington, Ky., and Capt. J. H. WINGATE, of Roanoke, Va. An extension of 4 miles will be built at once.

Duluth, Minn.—The Duluth St. Ry Co. proposes to adopt electric traction.

Minneapolis, Minn.—The Minneapolis St. Ry. Co. has decided to adopt the electric system, instead of cable as had been intended, on all its lines. There will be about 110 miles of electric line.

St. Paul, Minn.—Electricity is to be adopted on a number of the street railways in which Mr. LOWRY of Minneapolis, is interested.

Independence, Ia.—An electric railway is to be built, and $10,000 have been subscribed towards the project.

Helena, Mont.—The lines owned by Col. BROADWATER are to be operated by electricity.

Port Townsend, Wash.—The Port Townsend Electric St. Ry. Co. has awarded a contract for the construction of 3 miles of electric railway to the Thomson-Houston Electric Co., for about $100,000.

Seattle, Wash.—A company has been organized by Col. EWINGS, Capt. BALLARD, Mr. D. H. GILMAN, and others, to build the West St. & North End electric line, for which a franchise has already been granted.

Street Railways.—*Buffalo, N. Y.*—The franchise for a street railway on Seneca and several other streets will be sold at auction Feb. 6, by G. C. SHAFER, City Comptroller. The track is to be laid with the Richards girder rail, or other approved form of rail, but not a T rail. Cable or electric traction may be used.

Richmond, Va.—A bill has been introduced for the consolidation of the street railway companies of Richmond and Manchester.

Rome, Ga.—The Rome St. Ry. Co. has had surveys for an extension to Forestville made by Mr. F. C. HAND.

Superior, Wis.—The Superior Belt Line Ry. Co. has been incorporated by F. A. FLOWER, FRANK A. ROSS, and H. J. CAMPBELL. Capital stock, $1,250,000.

Cable Railway.—*Cleveland, O.*—The Cleveland Cable Ry. Co. has been granted ordinances permitting the extension of its lines on St. Clair St. and Madison St.

Elevated Railway.—*Boston, Mass.*—The West End St. Ry. Co. has applied to the Legislature for permission to build elevated railways to be operated by electricity or other power.

Dummy Lines.—*Chattanooga, Tenn.*—Surveys for a dummy line, which is to be built at once, are being made by Falconnet & Hogan, engineers, of Chattanooga.

Copenhagen, Tenn.—A company has been organized to build a dummy line from Copenhagen to Owens. Among the incorporators are J. C. BEENE and W. D. KELLEY, Jr., of South Pittsburg; Col. J. L. GAINES, of Nashville; WM. OWENS, of Owens; and W. L. KIRKPATRICK, of Copenhagen.

Independence, Ore.—The survey of the dummy line No Monmouth is to be started shortly.

HIGHWAYS.

New Jersey.—The bonding of the township of Bloomfield for the purposes of road construction has been discussed by the Bloomfield Improvement Association. The introduction of the question gave rise to many queries as to the plan of proceeding and amount of work to be done. It was stated that Bloomfield could take advantage of the legislation procured by the Belleville people and that no further special legislation was required. As to the amount of bonded debt to be assessed, it was thought that $100,000 was little enough, as there are at least 20 miles of road yet to be macadamized and this estimate included only main streets. It was the prevailing opinion that no macadamizing ought to be undertaken until a general plan of uniform grade for all the streets in the town was made.

Ohio.—A large mass meeting in favor of pikes, officered with vice-presidents from every voting precinct in Jefferson County, and presided over by ALEXANDER WEIDAY, was held Jan. 15 in the court house at Steubenville, O. Resolutions favoring a system of pikes throughout the county were passed and speeches made.

Kansas.—Three roads are to be built in Shawnee County. For particulars address Mr. J. M. BROWN, County Clerk, Topeka, Kan.

Colorado.—The Denver *Republican* states that there are many localities situated in too rugged a country for the construction of a railway or which have not enough traffic for a railway. These places could all be connected with some railway by passable, and in most cases by good wagon roads. Roads built in the mountains would have a solid foundation. Engineering skill would have to be invoked to make them smooth and to avoid steep grades. The effect of building good wagon roads would be noticeable in mining districts in an increase in the mineral output. There are many small mining camps in the mountains where development is checked by the impossibility or the great cost of getting ore to market. If these camps were connected by good wagon roads with some railway, the working of the mines could be made profitable.

CONTRACTING.

Paving Brick.—The following proposals for furnishing 750,000 paving brick have been received by the District Commissioners, Washington, D. C.: Washington Brick Machine Co.; $10.69 per 1,000 on the line of work; brick of ordinary size, J. A. Hayden; $18 per 1,000 for vitrified brick delivered at property yard, 9 x 4½ x 2½ ins.; or $36 for 9 x 9 x 2 ins.

Canal Work.—The following contracts have been awarded by EDWARD HANNAN, Superintendent of Public Works, Albany, N. Y.:

For improving 570 ft. and 360 ft. of the Glens Falls feeder and improving the waste weir of the same feeder, to Flood & Sherril, of Sandy Hill, at $7,130.50, $5,738.50, and $3,637.75 respectively, for the three pieces of work.

For deepening the Oneida River, to P. J. Brummelkamp, of Syracuse, at $8,050.

For improving waste weir at Adam's basin on the Erie Canal, 14 miles west of Rochester, to James Robinson, of Rochester, at $4,595.

Marble.—The following proposals for cut marble for the State House extension, have been received by the State House Commissioners, Boston, Mass.:

Patterson, Lee & Eisele; Lee marble, $366,000; canvas, $366,000; Tuckahoe, $366,000.

James Sinclair & Co.; Tuckahoe, $567,560.

Blue Ridge Marble Co.; Georgia, $284,706.

George Mann & Co.; Beaver Dam, $316,138.

Georgia Marble Co., Kenneson, $279,146.

Davidson & Sons; Gouverneur, $234,000; Pittsford, Vt., $243,600; Lee, $254,000.

Nucross Bros., Sheldon No. 1, $390,195; Sheldon No. 2, $397,195.

Southern Marble Co., $298,195; Lee, $310,195; Canaan, $289,195.

William Gray & Sons; Lee, $557,757.

Sheldon Marble Co.: No. 1 tooled, $391,793; rubbed, $374,288; No. 2, tooled, $350,850; rubbed, $335,350.

Sewers.—*Boston, Mass.*—The following proposals were received Jan. 20 by the City Engineer, WM. JACKSON, for the construction of Section 1 of the Brighton intercepting sewer. The contract was awarded to the National Construction Co. All the bidders were from Boston.

Bidders.	Earth Excav. and Refilling in Sewer Trench.	Tongued and Grooved Plank.	Brick Masonry, American Cement.	Brick Masonry, Portland Cement.	Concrete Masonry.	Rubble Stone Masonry.	Dimension Stone Masonry.	Spruce Lumber.	10 in. Drain Pipe.	Pipe for Regulator Connections	Earth Excav. and Refilling for Sewer Appur.	Gen'al Totals.
	1,822 lin. ft.	500 lin. ft.	1,100 cu. yds.	100 cu. yds.	700 cu. yds.	650 cu. yds.	2 cu. yds.	50,000 ft. B.M	1850 lin. ft.	68 lin. ft.	570 cu. yds	
National Construction Co.	$10.83	$10.20	$12.25	$14.25	$4.80	$5.25	$35.00	$27.00	$0.20	$0.75	$0.75	$
	19732.26	5100 00	13475 00	1425.00	3360.00	3412.50	70.00	1350.00	370.00	51.00	427 50	48773.26
Metropolitan Construction Co.	16.25	10.00	12.50	15.00	6.45	6.35	45.00	26.00	0.50	0.75	2.50	
	29607 50	5000.00	13750.00	1500.00	4515.00	4127.50	90.00	1300.00	925.00	51.00	1425.00	62291.00
John Cavanagh & Co.	22.00	6.50	13.50	15.00	5.75	6.50	35.00	25.00	0.65	1.00	1.15	
	40084.00	32.50	14850.00	1500.00	4025.00	3900.00	70.00	1250.00	1202.50	68.00	655.50	70855.00

Vermont Marble Co.; sample A, Rutland, $361,418; sample B, Rutland, $286,717; sample C, Sutherland Falls, $286,717.

Levees.—At Baton Rouge, La., contracts have been awarded as follows: L. Connella, Grand Rapids and Hudson, 14 cts. per cu. yd.; H. E. Hawsey, Towles, 14.85 cts.; P. J. Tyrrell, White Hall, 14½ cts.; S. D. Moody, California, 16.94 cts.; and Andrews, Ogden & Bently, Gordon, 14½ cts.

Dry Dock.—The Good-Intent Dry Dock Co., of New Orleans, La., has let a contract for pile driving and building a wharf to George Corbett.

The Buffalo N. Y., Harbor Improvements as planned by Capt. MAHAN, U. S. Eng'rs., contemplate the extension of the present breakwater from 6,355 ft. to 11,800 ft., with two attached but overlapping sections of 6,000 ft. and 2,000 ft. respectively. Capt. MAHAN asks for $400,000 this year, and with this he hopes to put a superstructure of masonry on 2,000 ft. of the present breakwater and to build 1,200 ft. of new structure.

PROPOSALS OPEN.

Canal Machinery.—Placing machinery in 13 locks of the Erie Canal. EDWARD HANNAN, Superintendent of Public Works, Albany, N. Y. Jan. 28.

Street Work.—Grading and cobblestone paving. J. P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. Jan. 29, 30.

Rip-Rap Stone.—About 6,000 cu. yds. R. P. & J. H. STAATS, 35 Broadway, New York City. Feb. 1.

Paving.—With mesquite blocks. BRYAN CALLAGHAN Mayor, San Antonio, Tex. Feb. 1.

Bridge.—Across Hampton River. Iron, wood or combination, 600 ft. long, 35 ft. wide. JOHN BOOKER, County Clerk, Hampton, Va. Feb. 1.

Building.—Masonic building, $30,000. J. B. LEGG, Architectural Co., Laredo, Tex. Feb. 1.

Sewers.—About 4 miles of 12 to 24-in. glazed tile main sewers, and outlet works. GEO. C. MOORE, City Clerk. Hannibal, Mo. Feb. 3.

Stone.—Edge stone, catch basin stones and granite paving blocks. A. L. LINCOLN, Jr., Chairman of Board of Selectmen, Brookline, Mass. Feb. 3.

Timber.—D. POTTINGER, Superintendent, Intercolonial Railway, Moncton, N. B. Feb. 3.

Dam.—Earth and masonry dam for reservoir "M." JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. Feb. 5.

Bridge.—Iron bridge across Cypress Creek; 180 ft., long, 16 ft. wide. J. J. MITCHELL, Judge of Probate, Florence, Ala. Feb. 10.

Water-Works.—Complete system. JAMES M. HOSKINS, Sioux Rapids, Ia. Feb. 12.

Building.—New criminal court building. THE COMMISSIONERS OF THE SINKING FUND, 280 Broadway, New York City. Feb. 12.

Bridges.—Seven truss bridges (see "Bridges and Canals"). J. H. PEARSON, Chief Engineer, Richmond, Nicholasville, Irvine & Beattyville R. R., Nicholasville, Ky. Feb. 15.

Bridge.—Across the Gunnison River. Cost complete, not to exceed $18,000. J. P. MAXWELL, State Engineer, Denver, Col. Feb. 15.

Water-Works.—THE CITY RECORDER, Hawarden, Ia. Feb. 20.

MANUFACTURING AND TECHNICAL.

Metal Market Prices.—*Rails.*—New York; $35 to $36; old rails, $28.50. Chicago; $37.50; old rails, $26.50 for iron and $20.75 to $21.25 for steel. Pittsburg; $35 to $36; old rails, $28.50 to $29 for iron, $24 to $24.50 for steel.

Track Material.—New York; angle bars, $2.15; spikes, $3.25. Pittsburg; splice bars, 2.10 to 2.20 cts.; spikes, $2.15. Or $2.25 delivered at Chicago or St. Louis; track bolts 3.10 cts. with square and 3.20 cts. with hexagon nuts. Chicago; splice bars, 2.25 cts. for steel and 1.90 to 2 cts. for iron; spikes, 2.25 cts.; track bolts, 2.80 to 2.85 cts. with square and 2.95 cts. 3 to with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought-iron; discounts as follows, 50 per cent. on black butt-welded, 42½ on galvanized butt welded, 62½ on black lap-welded 50 on galvanized lap-welded.

Lead.—New York, 3.87½ cts. Chicago, 3.67½ to 3.70 cts. St. Louis, 3.60 cts.

Tests of Alsen's Portland Cement, as lately made by Col. D. C. HOUSTON, U. S. Corps of Engineers, are reported as follows: The cement was taken from deliveries made by Sinclair & Babson, of New York, for use in the construction of a sea wall at Governor's Island. The tests were made neat without sand and the average for tensile stress per square in was—In one day, 318 lbs.; in seven days, 550 lbs.; in thirty days, 738 lbs. This is a showing that is as gratifying to the makers as it is interesting to engineers and architects. The Alsen makers claim that these almost unexcelled results are due to the fineness with which the cement is ground, as it is passed through a sieve of 2,500 meshes per square inch. It weighs 103 to 105 lbs. per United States struck bushel as against the 112 and 115 lbs. of other cements; for this reason the makers state that the barrels of this cement contain by actual measurement about ten per cent. more cement per barrel than the heavier makes, though the weight of the barrel is the same in both cases.

Sewer Pipe.—H. A. WARNER, of New Haven, Conn., agent for the Ohio Vitrified Clay Drain & Sewer Pipe, who puts on the Eastern market large quantities of the Akron and River pipe, states that the latter has recently been greatly improved in smoothness by the use of natural gas in burning.

The Western Tunnel Co., of Chicago, has been incorporated by CHARLES FITZIMMONS, EUGENE GARNET and A. G. JENKS. Capital stock $15,000.

The Racine Dredge Co. has been organized at Racine Wis. Capital stock, $25,000.

The Troy Public Works Co., of Troy, N. Y., has elected the following officers: President, R. W. SHERMAN; Vice-President and Treasurer, M. MCDONOUGH; Secretary, W. L. MCDONOUGH.

The Strong Locomotive has been running on the Cincinnati, Hamilton & Dayton recently, and last week was in a collision on that road, but was not much injured. It is stated that works are to be erected at Cincinnati for building these locomotives, and that Mr. J. H. STEWART, formerly General Manager of the Cincinnati, Washington & Baltimore, will be in charge of these works.

Pipe Works.—The Colorado Coal & Iron Co., of Pueblo, Col., will establish a pipe foundry at a cost of $75,000.

Brick.—The Erskine Vitrified Brick Co. has been incorporated at Kansas City, Mo.

Plate Rolling Mill.—The plant for rolling armor plate, built by the Niles Tool Works for the navy yard San Francisco, Cal., weighs 484,000 lbs., or 64,000 lbs. more than was figured. The two largest rolls weigh 65,000 lbs. each. The three rolls were forged by the Cleveland City Forge & Iron Co.

End Frames for Cars.—Among recent improvements by the Pullman Palace Car Company in passenger car construction is the use of an angle iron end frame which extends from the bottom of the car on one side, over the top and down to the bottom on the other side. This is used in connection with a sheet steel horizontal end plate located just back of the buffer, which is especially devised to prevent the telescoping of cars by other cars, or locomotives in case of collision. This design was invented by Mr. SESSIONS, manager of the Pullman works.

Cars.—The Wason Car Co., of Springfield, Mass., has built 5 passenger cars and 1 combination car for the Connecticut River; also 3 passenger cars for Yucatan.

The Gilbert Car Co., of West Troy, N. Y., has shipped some passengers cars to the Argentine Republic.

The Harrisburg Car Mfg. Co. will, it is said, be sold out to an English syndicate.

The U. S. Rolling Stock Co., of Anniston, Ala., has an order for 50 cars for the Alabama Great Southern.

The Barney & Smith Mfg. Co., of Dayton, O., is building 400 hopper gondola cars for the New York, Pennsylvania & Ohio.

The Carolina & Oil Creosote Co., of Wilmington, N. C., will extend and improve its plant for the treatment of timber with wood creosote oil. The company has closed contracts for furnishing creosoted lumber to a manufacturing concern in Providence, R. I., and to the Dock Department of the city of New York. The fourth cargo of creosoted piling, timber and lumber for the Nicaragua Canal will be shipped shortly.

Electric Headlights.—Mr. PRESCOTT, Superintendent of Motive Power, of the Vandalia road, has orders from President MCKEEN to close a contract with the National Electric Headlight Co., of Indianapolis, for equipping all the passenger engines running between Indianapolis and St. Louis.

Locomotives.—The Brooks Locomotive Works, of Dunkirk, N. Y., have an order for two engines for the Winona & Southwestern.

The Manchester Locomotive Works, of Manchester, N. H., have an order for two ten-wheel engines, with driving wheels 66 ins. diameter, for the Boston, Concord & Montreal.

The Dickson Mfg. Co., of Scranton, Pa., has an order for 25 engines for the Ontario, Carbondale & Scranton.

The Baldwin Locomotive Works, of Philadelphia Pa., have delivered 25 of an order for 50 engines for the Pennsylvania. The works are building 5 more engines for the Savannah, Americus & Montgomery; also 4 eight-wheel engines for fast passenger service, and 2 eight-wheel engines for freight service, for the Philadelphia & Seashore.

The works are building 2 consolidation engines of the Mason bogie type for the Nexican Central, and a compound Fairlie type engine for Brazil.

A logging locomotive and cars are wanted by H. M. Sciple & Co., 3rd and Arch Sts., Philadelphia, Pa.

The Dunham Mfg. Co. reports active business in its varied lines for the last half of December and first half of January, orders for the Dunham storm-proof car door, improved and strengthened, now placed and specified for over 15,000 cars.

National Filter.—The National Water Purifying Co. have just closed contracts for National Filter Plant with the Water-Works Co. of Porterville, Cal. The Central Thomson-Houston Co., Cincinnati, O. The St. George Hotel, Dallas, Tex. Belding, Paul & Co's Silk Works, Montreal, Can.

BRIDGES, TUNNELS, AND CANALS.

New York, N. Y.—A bill has beenintroduced in to the New York State Legislature authorizing the building of a new bridge at McComb's Dam under the supervision of the Department of Public Works. The cost of the structure, as fixed in the bill, is $500,000.

Troy, N. Y.—A bill has been introduced into the State Legislature incorporating the Troy & Green Island Bridge Co. to build a bridge across the Hudson River at this place.

Pittsburg, Pa.—A charter has been granted to the 36th St. Bridge Co., of Pittsburg, Pa. The incorporators are: J. P. WALKER, GEO. WALKER, PETER SCHLERNITZAUER, Jr., LORENZ WALKER, and J. R. SCHLERNITZAUER.

Portland, Pa.—The bridge just completed at this place by the Pennsylvania, Poughkeepsie & Boston R. R. Co., is 1,921 ft. long including approaches. The bridge proper is 925 ft. 6 in. long and the viaduct approaches are 993 ft. 7 ins. long.

Cincinnati, O.—A bill will be introduced into the Ohio State Legislature authorizing $15,000 of additional bonds to be issued by the County Commissioners of Hamilton County the proceeds to be used in enlarging the masonry wing walls of the Colerain Ave. bridge at Cincinnati, O.

Elizabeth City Co., Va.—Bids will be received up to Feb. 1, 1890, by the Clerk of the Board of Supervisors of Elizabeth City County, Va., for a bridge across the Hampton River. The plans and specifications are for a bridge wholly of iron and stone except decking; part of iron and part of wood; and wholly of wood. The bridge shall be 35 ft. wide, including walks, and 600 ft. long. The structure shall not cost more than $15,000.

Craig Mineral R. R.—Three of the piers for the large bridge across the James River, Virginia, have been completed.

Columbia, Newberry & Laurens.—The bridge being built by this company across the Broad River, S. C., will be completed by Feb. 1.

Atlanta, Ga.—JOHN T. COOPER, Clerk Fulton County Commissioners of Roads and Revenues, will receive bids until Feb. 5, 1890, for building an iron bridge across the Chattahoochee River between Fulton and Cobb Counties, Georgia. The bridge will consist of two spans of 136 ft

each, and 400 ft. of trestle work; the piers and abutments to be of masonry.

Alabama Midland R. R.—The contract for building the railway bridge across the Cahaba River, Alabama, has been let to Carter Bros. of Louisville, Ky., and construction will commence at once.

Richmond, Nicholasville, Irvine & Beattyville R. R.—Proposals for the construction of seven bridges will be received until Feb. 15 by J. H. PEARSON, Chief Engineer, Nicholasville, Ky. All these spans are to be of the combination truss pattern, with iron or steel floor beams. Bidders will make proposals on their own style of bridge, but the Thacher truss is preferred. Bids to include transportation to Richmond, Ky., or Nicholasville, Ky., and erection. Other important bridge work is contemplated. Plans are being prepared for the second crossing of the Kentucky River at Irvine, Ky., consisting of one channel span of 250 ft., eight spans of 100 ft. and 210 ft. of viaduct, all iron and steel. Proposals for this work will be invited shortly. Of the seven bridges above mentioned, there is one of 180 ft. span, two of 150 ft. three of 100 ft. and one of 80 ft.; the 180 ft. and one 150 ft. spans are deck structures.

Louisville, Ky.—City Engineer SCOWDEN, has completed the plans for the Reservoir Avenue Bridge and nearly all of the contracts have been let. Work will begin soon.

Milwaukee, Wis.—The Milwaukee & Wauwatosa Motor R'y. Co. has let the contract for the large steel viaduct across the Menominee Valley in Wauwatosa, to the Milwaukee Bridge & Iron Works for $75,000. The total length of the viaduct is 2,085 ft., roadway 20 ft. wide with two 5 ft. walks, making a total width of 30 ft.

Louisville, Neb.—In regard to this bridge noted in our last issue the scheme is as follows: Louisville precinct, in Cass county, proposes to built the bridge by voting $10,000 of bonds for the purpose and present the bridge to Cass and Sarpy counties, provided each county will agree to keep one-half of the bridge in repair. The reason given for building the bridge is to obtain an independent crossing and thus avoid the excessive tolls charged for crossing the present bridge at South Bend

Burlington, Ia.—A committee has been appointed to consider and perfect a plan for a combined wagon and railway bridge across the Mississippi River at this place. A charter for the bridge was granted at the last Congress.

St. Louis, Mo.—Earthwork to the extent of 10,000 cu. yds. was swept away at the east end of the Merchant's Bridge by the recent rise in the river. Piles are being driven below and above the earthwork next the east pier Willow mattresses will be used to secure the work in the future. The iron cylinders set in concrete were exposed to the base but were not injured. The workmen engaged on the bridge approach were laid off several days on account of the freshet preventing operations.

New Orleans & Northwestern R. R.—The contract for building the bridge across the Tensas River for this railway has been let to Shailer & Schnigiau, of Chicago, Ill.

Fort Worth, Tex.—The contract for constructing the approaches for the bridge at Rock Ford Crossing has been let to F. M. Ford, for $14,000.

Lavaca Co. Tex.—Bids will be received by JOHN BUCHANAN, Clerk of County Court, Lavaca County, Tex., for an iron bridge across Rocky Creek.

Denver, Col,—Plans and specifications will be received until Feb. 15 for an iron bridge across the Gunnison River, in Delta County. J. P. MAXWELL, State Engineer.

Proposed.—Bridges are proposed at Santuc, S. C., Birmingham, Ala., San Antonio, Tex., and Lyons, Ia.

Tunnels.—*Montreal, P. Q.*—The city will apply to the next Legislature for authority to make a loan of $200,000 for the construction of a tunnel from St. Paul to Craig Street through Jacques Cartier Square and Champ de Mars.

Canals.—The contracts for preparing plans and specifications for the Basha Branch Canal have been awarded to Simons & Huger, of Summerville, S. C.

ELECTRICAL.

Electric Light.—*Middlebury, Vt.*—The Edison Electric Light Co. and A. T. TUPPER have made propositions to put in a plant.

Jersey City, N. J.—A franchise has been granted to the Bergen Electric Heat, Light & Power Co.

Elizabeth, Pa.—The council has awarded a 5 years contract to the Fort Wayne Electric Light Co.

Radford, Va.—The Central City Electric Light Co. has been organized.

Grafton, W. Va.—A proposition to light the town by electricity has been made by a company headed by Hon. A. R. GRAFTON.

New Berne, N. C.—The New Berne Electric Light & Power Co. has been incorporated. President, A. H. LEFTWICH; Secretary, U. S. MACE. Capital stock, $75,000.

Salineville, O.—It is proposed to issue bonds for $5,000.

Macomb, Ill,—The Macomb Electric Light Co. has been incorporated by CHARLES KETTERON, H. W. CUMMINGS and J. N. RUME. Capital stock $25,000.

Minonk, Ill.—The Minonk Electric Light & Power Co. has been incorporated by M. L. NEWELL, A. B. KIPP and G. W. WEBER. Capital stock, $15,000.

Rapid City, Dak.—A contract has been let for an incandescent plant.

Denver, Col.—The only bid for electric lighting during the current year was from the Consolidated Electric Light Co.; $20 per month for tower lights, $18 per month for arc lights.

Highlands, Col.—A contract for 5 years has been awarded to the Denver Illuminating Light Co.; $12.50 per month per arc light of 2,000 c. p.; incandescent house lamps at a meter rate of 8-10 of 1 cent per lamp of 16 c. p., actual burning time. The company's franchise is for 20 years.

Fort Worth, Tex.—An electric light plant, with engine of 160 H. P., is to be put in at a cost of $27,000. For particulars address the mayor.

Marlin, Tex.—Thomas & Gorman, of Houston, propose to put in an electric light plant.

St. John, N. B.—J. Calkin has made a proposition to light the streets by electricity.

SEWERAGE AND MUNICIPAL.

Pottsville, Pa.—The Gamewell system of fire alarm telegraph is to be put in. E. D. BRADY is the local agent.

Toronto, Ont.—The following is a summary of the report of the City Engineer: Total expenditure of department, $1,605,474.70. Pavement constructed: cedar, 12.84 miles; asphalt, 3.11; macadam, 0.38; total 16.33 miles. Sidewalks; stone flags, 4 miles; granolithic, 0.50; asphalt, 0.12; total, 4.62 miles. Sewers, 16.06 miles, including 361 manholes and 603 gulleys. Sewers built by day labor, 4 miles. House connections to sewers, 9.50 miles. Wooden sidewalks laid, 44.5 miles. The streets were renumbered last year; number of streets, 870; tablets erected, 3,165. Stone blocks were laid between the street railway tracks for 4.34 miles.

Sewerage.—*Marlboro, Mass.*—The State Board of Health has approved the plans prepared by M. M. TIDD, C. E., of Boston, for sewerage and sewage disposal.

Waltham, Mass.—It is proposed to bond the city for $300,000 for sewers.

Providence, R. I.—The City Engineer has been directed to complete the plans for the Elmwood sewer.

Norwich, N. Y.—The State Board of Health has investigated the sanitary condition. Civil Engineer C. C. BROWN, of Union College, reports there are 13 miles of streets of which 8 need sewers very much. It would cost $60,000 to sewer this portion, or about $30,000 to sewer those streets actually demanding it.

Flatbush, N. Y.—Plans for surface drainage in several streets have been prepared for the Sewer Commissioners by GARRET BERGEN, C. E.

Jersey City, N. J.—The Joint Sewer Commissioners of Jersey City and West Hoboken have decided to construct a new sewer that will drain all of West Hoboken and part of Jersey City Heights. The sewer will cost $250,000, and the work will be in charge of Surveyor MOYLAN, of Jersey City.

Atlanta, Ga.—Mr. HAAS, Chairman of the Sewer Committee, wants to build 10 miles of sewers this year at a cost of $150,000.

Talladega, Ala.—Bonds for $25,000 for sewerage purposes are expected to be issued.

Florence, Ala.—Plans for sewerage are being prepared by R. F. HARTFORD, C. E., of Chattanooga, Tenn.

Gas Works.—*Washington, D. C.*—The District Commissioners will investigate the question as to the desirability of the Government purchasing the works of the Washington Gas Light Co.

Atlanta, Ga.—The Southern Light & Fuel Gas Co. has been incorporated by W. B. MILES, J. R. GRAMBINO and T. J. HIGHTOWER, to establish works on the Bedelman system. Capital stock, $100,000.

Street Work.—*Long Branch, N. J.*—It is proposed to issue $150,000 in bonds for street paving.

Moundsville, W. Va.—The issue of bonds for $20,000 for brick paving is contemplated.

Macon, Ga.—The city will issue bonds for $200,000 for street and other improvements.

Newark, O.—The city has decided to use the Porter fire-brick for street paving.

Topeka, Kan.—A resolution has been adopted directing the City Engineer to prepare plans, specifications and estimates, block by block, for the grading, curbing and paving, with Colorado sand stone, native blue limestone, cedar blocks and vitrified brick, of Sixth St. from the viaduct to Locust St.

Street Sprinkling.—The St. Louis Improved Street Sprinkling Co. was the lowest bidder on several districts at St. Louis, Mo.

WATER-WORKS.

NEW ENGLAND.

Portsmouth, N. H.—The committee appointed to negotiate for the purchase of the aqueduct company's works, has been granted power to employ engineers to survey the property, and an extension of time in which to report.

Lancaster, N. H.—A vote will be taken in March on the question of establishing works. Estimated cost, $50,000. It is reported that a Woonsocket, R. I., party has made a proposition to the town. Also that a stock company has been formed with a capital stock of $50,000.

Waltham, Mass.—A resolution has been adopted by the City Council directing the Mayor to prepare a bill to be presented to the Legislature, authorizing the town to issue bonds for $100,000 for constructing works.

Boston, Mass.—The Board of Fire Commissioners has reported adversely on the establishment of a pipe system through the business portion of the city.

MIDDLE.

Long Island City, N. Y.—At a recent meeting of the Water Board it was decided to have a bill introduced in the Legislature authorizing the city to increase its water supply.

Cattaraugus, N. Y.—O. WHITE informs us, that nothing definite has yet been done toward the construction of works.

Rochester, N. Y.—A second report of the special committee, appointed by the Chamber of Commerce to act with the select committee of the Common Council, has been submitted. The following summary is from the *Herald* of that city.

Briefly, we may say that this committee has accepted the judgment of the expert engineers, Messrs. FTELEY and FANNING, employed by it, and advise, first, that an additional water supply is necessary, and secondly, that it should be secured by the construction of an all gravity system from Richmond Mills to this city. The grounds for these recommendations are clearly set forth in the report. The cost of the conduit is estimated by the experts at $1,087,426, and the joint committee recommended the passage of an enabling act to be drawn for $2,500,000 to provide for the settlement of damages and all contingencies.

Among other suggestions made by the report is this: That the cost of delivering the water to consumers shall be met by a system of rates that will completely cover it, instead of placing the rates so low that a deficiency that has to be met by a direct tax upon real estate shall occur from year to year.

Asbury Park, N. J.—A rival to Monmouth Water Co. has been organized, and at a recent meeting of the township committee, the new syndicate, through its representative, R. TENBRECK STOUT, of Ocean Grove, offered to give the township $400 per mile for every mile of pipe running through the township roads. Gov. GREEN'S corporation only offers $10 per year for each mile of pipe used in the township, and unless these figures are raised, it is reported that the new company will be given the franchise.

Elizabeth, N. J.—The Union Water Co. (mentioned as "A new company" in our issue of Jan. 18) has filed articles of incorporation, and proposes to establish new works on the plan there outlined. The capital stock is $100,000. Other stockholders are: EUGENE F. FULLER, of Jersey City; ROBERT LELAND, of Brooklyn, and CALVIN DETRICK, of New Brighton. AMOS CLARK is at the head of the enterprise.

Pittsburg, Pa.—Superintendent GEORGE H. BROWN has sent us the following:

During the present year it is proposed to spend about $100,000 in extending mains, and about $30,000 in extending small lines for domestic supply.

Chartiers and Mansfield, Pa.—The Monongahela Water Co. will begin work in the spring on the proposed works that are designed to supply these boroughs with water. The new plant will cost about $250,000. A reservoir will be built on one of the hills, back of the towns. Water will be supplied from the Ohio River, on the bank of which will be built an extensive pumping station. On Feb. 10, the Monongahela Water Co. will ask for a charter to extend its field of operations, in order to take in the vicinity about the proposed new plant.

Beaver, Pa.—A syndicate of capitalists will apply for a charter for the incorporation of the Beaver Valley Water Co., on Feb. 8. The object of the company is to supply the towns of Beaver, Bridgewater, Beaver Falls, New Brighton, Fallston, Rochester, Freedom and Phillipsburg with water. Among those interested are: W. S. SHALLENBERGER, W. H. HARTMAN, JOHN CONWAY, JOHN R. EAKIN, RICHARD R. QUAY, JOHN M. BUCHANNAN and JOHN G. MACCONNELL.

Baltimore, Md.—R. D. Wood & Co., of Philadelphia, Pa., has been awarded the contract for furnishing cast-iron pipe at $85,056.60; and J. D. Lacy & Co., the contract for cast-iron castings at 2 4-10 cts. per lb. for pipe fittings and 2 8-100 cts. per lb. for special castings.

Bel Air, Md.—It is reported that A. T. LACKIE, has prepared plans and estimates for a system of works. Water will be pumped from either Bynum's or Winter's run to a stand-pipe, with a capacity for 200,000 galls. The estimated cost is $200,000.

SOUTHERN

Gordonsville, Va.—JOHN G. DAVENPORT informs us that the new works have been completed. John Jacoby of Bridgeport, Conn., was the contractor for the city. Designing Engineer, JOSEPH ALLES, of Lynchburg. Engineer in Charge of Surveys, W. H. PORTER. Chairman of the Water Board, C. F. MYERS. Cost, $16,000, procured by bonds.

Radford, Va.—The contract for constructing the reservoir and engine house has been awarded. Engineer HOWARD MURPHY, of Philadelphia, Pa., can furnish information.

Norfolk, Va.—The Board of Water Commissioners have asked for an appropriation of $60,000 for improving the pumping machinery.

Wilmington, N. C.—JAMES H. MCKEE is preparing plans for a stand-pipe system of works to be established at the depot of the Cape Fear & Yadkin Valley Railroad at Point Peter.

Batesburg, S. C.—THOMAS E. MITCHELL sends us the following information:

The present supply of surface water is unsatisfactory. Steps are being taken to prepare a plan to prevent the surface water from entering the wells, or to have artesian wells. Dr. E. F. STROTHER, Mayor, may be addressed for information.

Sandersville, Ga.—Address the Mayor for information regarding the projected works.

Savannah, Ga.—The City Council has appropriated $20,000 for improvements.

Trenton, Ga.—There has been some talk of bringing water from a spring, on the mountain, to supply the town, but no definite project has been completed.

Tallahassee, Fla.—The Tallahassee Suburban Land Co. has been incorporated with authority to construct and operate works. The capital stock is $50,000.

Anniston, Ala.—The following data is taken from a recent report made by JOHN H. TURNER, Chief Engineer of the Anniston Water Co.:

The works were transferred to the Anniston Water Co in Oct. 1889. The pumping station at Cold Water is under roof and ready for the machinery.

The source of supply has been cleaned out, dams built, with retaining walls entirely around it, thereby protecting it from pollutions from any source.

The engines will be ready to ship by Jan. 15. Pipe-laying commenced Dec. 10, and about 4,000 ft. of 12-in., and 3,500 ft. of 6-in. pipe has been laid, and it is being pushed rapidly. The new works will be in operation about May 1.

Contracts have been entered into between the city and the company for 140 hydrants at $50 per annum each, for a term of 20 years; also with the Woodstock Iron Co. for 10 years at $6,000 per annum; also with the Pipe Works for 20 years at $5,000 per year. The steam power is sufficient to raise 8,000,000 galls. into the reservoir, which will have a capacity of 10,000,000 galls., and be so situated that the city will be supplied by a gravity head of 223 ft.

Thirty year 6 per cent. gold bonds are now being offered for sale by Stein Bros., of Baltimore, Md.

Lake Charles, La.—The Mayor and City Council are negotiating with A. Menger, of New York, for a system of water-works and electric lights. He proposes to put up the two plants at a cost of $83,000, provided the town will give him an exclusive charter for a period of 30 years and pay an annual rental of $6,000.

West Knoxville, Tenn.—Contracts for constructing works will probably be let soon. The proposed source of supply is springs. Mayor, P. F. FOE.

Middlesborough, Ky.—C. W. LIVERMORE has sent us the following:

At present the Middlesborough Town Co. is furnishing residents with water from wells. Preparations are being make to augment the present supply with an addition of 12 000 galls. per day, from a mountain stream, and surveys are now being made. President, ALEXANDER A. ARTHUR. Resident Manager, J. M. BROOKS; Secretary and Treasurer, J. B. CARY.

NORTH CENTRAL.

London, O.—Contractor JOHN P. MARTIN, of Xenia, O., has sent us the following:

Work was begun on Dec. 20, 1889, by the John P. Martin Co., and is to be completed July 1, 1890. A 1,500,000-gall. pump will raise water from Cook's system of 6 in. tube wells, to a stand-pipe, 20 ft. in diameter by 125 ft. high. There will be 4 miles of 4 to 14-in. cast-iron mains, and 100 hydrants. The city will pay $55 per hydrant for a term of 20 years. Estimated cost, $110,000.

Princeton, Ind.—We have received the following from JAS. B. GAMBLE, Mayor:

No date has been decided upon for letting contracts. The works will probably be built by a private company. Water will be pumped from wells to a stand-pipe. The estimated cost is $15,000 to $25,000.

Vincennes, Ind.—Press reports state that the works have been rendered entirely useless by the recent floods.

Red Jacket, Mich.—The following information is from W. C. O'LEARY.

Works are being constructed by the Calumet & Hecla Mining Co. J. N. WRIGHT, of Calumet, Mich., is Resident Superintendent. Estimated cost, $50,000. Water will be pumped from Lake Superior, 4 miles distant, to a stand-pipe. J. D. CUDDIHY is Village President.

Pana, Ill.—A pipe line is to be laid from Springsides to the depot to supply water to the Illinois Central R. R. Surveys are being made by Engineer PORTER.

Peoria, Ill.—Contracts for furnishing two stand-pipes have been awarded to the Porter Mfg. Co., of Syracuse, N. Y. They will be 30 ft. in diameter by 85 ft. high, and 25 ft. in diameter by 120 ft. high, respectively.

Metropolis City, Ill.—We have received the following information from W. R. BROWN:

The Metropolis Water-Works Co. will construct works. Contracts will be let in the spring. Estimated cost, $40,000. Water will be pumped from the Ohio River to a stand-pipe.

Delavan, Wis.—The contract for establishing works was let on Jan. 20. Estimated cost, $20,000.

NORTHWESTERN.

Storm Lake, Ia.—A vote will soon be taken on the question of issuing $30,000 for constructing works.

Lucerne, Minn.—Editor FRED. A. VAN DUZEE has sent us the following:

The question of establishing works is yet much in embryo. It is being agitated and something may be done soon. This place is in the artesian well region, and that system, with a pump and stand-pipe, will probably be adopted ultimately.

Sioux Rapids, Ia.—Sealed proposals will be received until Feb. 12, for the furnishing materials, and doing all work, necessary to the completion and construction of a system of works. Bids will be received for the entire work complete, and for any distinctive part thereof. The members of the Water Committee are: JAMES M. HOSKINS, LYMAN JOHNSON, J. P. FARMER.

Hawarden, Ia.—Bids will be received until Feb. 20, for furnishing materials and doing all work, or for the entire work complete. The City Recorder will furnish information.

Adrian, Minn.—A. J. MCKENZIE informs us that it has not been decided whether the city will build the works or let the contract. Water would probably be pumped from a well to a tank. Estimated cost, $5,000 to $7,000.

Litchfield, Minn.—We have received the following information from A. D. Ross:

Contracts will be let on April 1. The works will be built and owned by the city. Bonds for $25,000 will be issued. Hydrants will be used. Water will be pumped from wells to a reservoir. Population, 3,000.

Plantier, Minn.—W. LAWTON informs us that a small system of works will be constructed. The supply will be taken from wells. J. P. WASTE is Chairman of the Water Board.

Girard, Kan.—The Montauk Water Co., of New York, has given bond in the sum of $5,000 to build a system of works inside of nine months. Work will be commenced at once.

Marysville, Kan.—E. E. STEVENS, of Beloit, Kan., informs us that the new works were to be completed on Jan. 20. They were built by the Marysville Water Co. President E. E. STEVENS; Secretary and Designing Engineer, J. S. SIMMONS. Cost, $50,000. Water is pumped from 20 wells, driven near Blue River, to a stand-pipe.

Blue Rapids, Kan.—Regarding the new works, T. E. MARCY sends us the following:

The Central Water-Works Construction Co., of Kansas City, Mo., was awarded the contract for constructing works, to be completed by April 1. Pipe-laying has been completed. The supply will be taken from wells. Hydrants will be used. The estimated cost is $16,000.

Cozad, Neb.—The contract for a small system of works will be let to A. T. Gatewood or G. W. Fox. Estimated cost, $5,000. Water will probably be pumped from a canal to a reservoir, and be used for fire protection and domestic supply.

Atkinson, Neb.—We have received the following information from W. A. WHEELER:

Contracts will be let in the spring, and works are to be completed by September. Hydrants will be used. The supply will be taken from wells. Estimated cost, $8 000, to be procured by town bonds. Address A. L. MORSE, Mayor.

South Omaha, Neb.—P. COCKRELL informs us that the work to be done in this place is an extension of the Omaha works, owned and operated by the American Water-Works Co.

Miller, Dak.—We have received the following:

There is a prospect for putting down about 40 wells next spring in this vicinity. The new works will be owned by the city. Estimated cost, $16,000. Chairman of Water Board, W. W. EMMONS.

Gettysburgh, Dak.—The supply is to be furnished by an artesian well; it has already been sunk to a depth of 1,360 ft., and will probably be sunk to a depth of 1,300 ft. and will probably be sunk deeper this year. Water will be used for fire protection and domestic supply. Information can be obtained from JAMES BRYSON. A. D. PARKER is Chairman of the Water Board.

Helena, Mont.—The city has signed a five year's contract with the Helena Consolidated Water Co. The city pays the company of the yearly revenues of Helena, during the term of five years, as follows:

$20 per year out of the general fund for each hydrant for water for sewerage, which aggregates	$4,000
Out of the fire fund, $80 per year, aggregating	16,000
Total per year	$20,000

For each additional hydrant over the 200 required to be established, the city will pay $16.75, and $58.75 for sewerage and fire, respectively. A considerable amount of improvements and additions will probably be made at once. GEORGE F. WOOLSTON is at the head of the new company.

SOUTHWESTERN.

Monticello, Ark.—E. BORCHARDT informs us that he is constructing the new works, and that water will be pumped from an artesian well to a stand-pipe.

Cuero, Tex.—The foundation for the stand-pipe for the new works is completed, and the iron to build the stand pipe has been received. Pipe laying is progressing rapidly.

Marlin, Tex.—Thomas & Gorman, of Houston, have been awarded the contract to construct works.

Hillsboro, Tex.—It is reported that A. T. ROSE is organizing a company to build works. The supply will be taken from an artesian well.

Boulder, Col.—It is now proposed to get water for domestic and other use from the foot of the range. If this plan is carried out, it will require the laying of about 22 miles of pipe, or the digging of a ditch.

South Denver, Col.—The Citizens' Water Co., of Denver, is negotiating with the trustees for a right of way for a 36-in. main through the South Side.

Granada, Col.—Warrants on the town for $50,000 have been drawn in favor of Thomas Doak, to enable him to raise funds with which to construct works.

Denver, Col.—It is reported that the plant of the Denver Water Co. has been purchased by, and will hereafter be known as, the American Water-Works Co. It will be under the same management as the company of that name in Omaha. The present system is to be entirely reconstructed and enlarged. The improvements will include the laying of a considerable amount of 48 in. pipe. Details for the transfer of property, and of the plans and specifications for the improvements, have not been completed, but will be soon.——The Citizens Water Co. has recently awarded contracts for 40 miles of cast-iron pipe, 6 to 40 ins. in diameter. The high service pipe is now being constructed from the Platte Cañon to the city. The company has ordered a pipe line from Dome Rock to the reservoir site just north of Platt Cañon. This pipe will be 48 ins. in diameter. A large force is also engaged in the construction of a dam at the break in the hog-back which forms the front of the reservoir.

Springer, N. M.—On Jan. 7, Contractor S. T. Wicks tendered to La Compania de Agua Cristalina de Manantial the works in a complete state, and the system has been accepted by the directors of the company.

PACIFIC.

North Yakima, Wash.—Active preparation are in progress for the early completion of a system of works. The company intend tapping the Yakima River, near the mouth of the Natches. The right of way for a portion of the distance has been secured, as well as 10 acres in the northern part of the city for the location of their water power and machinery.

Oakland, Cal.—The Contra Costa Water Co. has purchased 33 acres of the Laundry Farm tract, beyond Fruitvale. The company now owns 51 acres of this tract. It is probable that two small reservoirs will be constructed on this land.

San Diego, Cal.—Bonds to the amount of $3,000,000 have been placed by the Mount Tecarte Water Co. They will take steps at once to construct a water storage and distribution system of works.

CANADA.

Annapolis, N. S.—A new system of works has just been completed.

Montreal, P. Q.—The water department has forwarded an application for an appropriation of $70,000 to be expended in laying mains.

Winnipeg, Manitoba.—We quote the following from Mayor PEARSONS annual message:

I need say nothing to you about this matter, for you fully realize the vital importance to our city of this matter; but some scheme for the extension of the present system that will be satisfactory to the citizens must be devised, either by purchase at a fair valuation of the present water-works, or the building of our own system in connection with the water power.

ARTESIAN WELLS.

Blakely, Ga.—A well is to be sunk.

Abilene, Tex.—Bids are wanted by the Abilene Progressive Committee for sinking a well.

Hillsboro, Tex.—Address A. T. ROSE for information regarding a projected well.

Henrietta, Tex.—The Henrietta Improvement Co. will sink a well.

Austin, Tex.—Another well is to be sunk at Capitol grounds.

IRRIGATION.

Cheyenne, Wyo.—The Interstate Canal & Water Supply Co. has been incorporated with a capital stock of $2,000,000. Water is to be diverted from the North Platte River in Laramie County, at a point near the Nebraska line.

Glorieta, N. M.—The Rio Grande Valley Water Co. is about to begin work on a large pipe line to extend from Glorieta to San Pedro. The line will be 65 miles in length and the project is to lay wrought-steel pipe 4 ft. in diameter, to convey the Pecos River waters to San Pedro.

The line as surveyed passes through Pecos, thence to Galisteo, and crosses the mesa near the Canoncito charcoal ovens, reaching Pedro through a gap in the mountains some 12 miles southeast of Cerrillos. President ARMSTEAD states that it will cost $5,000,000 to carry out the enterprise. Mr. SAVAGE is the Chief Engineer.

Denver, Col.—The Colorado Land & Canal Co. has filed articles of incorporation. It proposes to extend the Pueblo ditch system through Pueblo, Kiowa, and Cheyenne Counties, east to the State line, a distance of about 22 miles. The estimated cost of their project is $5,000,000. President T. C. HENRY is reported as stating that work on a large scale will be commenced as soon as the State Land Board agrees to the company's proposition. A reservoir will be constructed at Arlington Springs, covering an area of 12,000 acres, and there will be 100 natural reservoirs, with areas from 100 to 20,000 acres, respectively. It will require about 5 years to complete the work.